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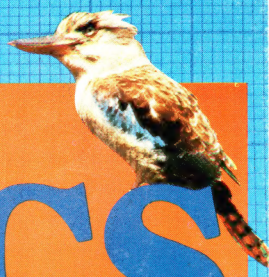

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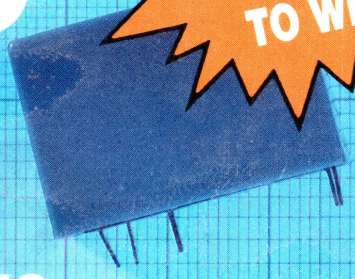

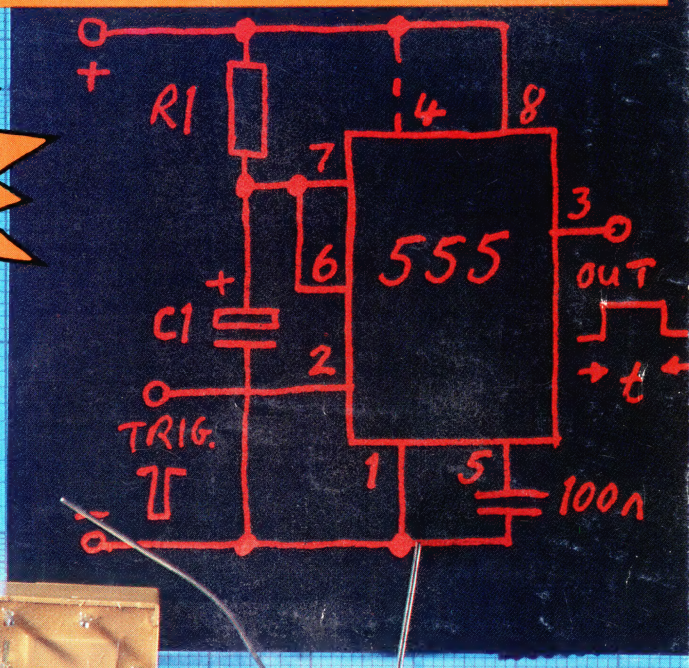

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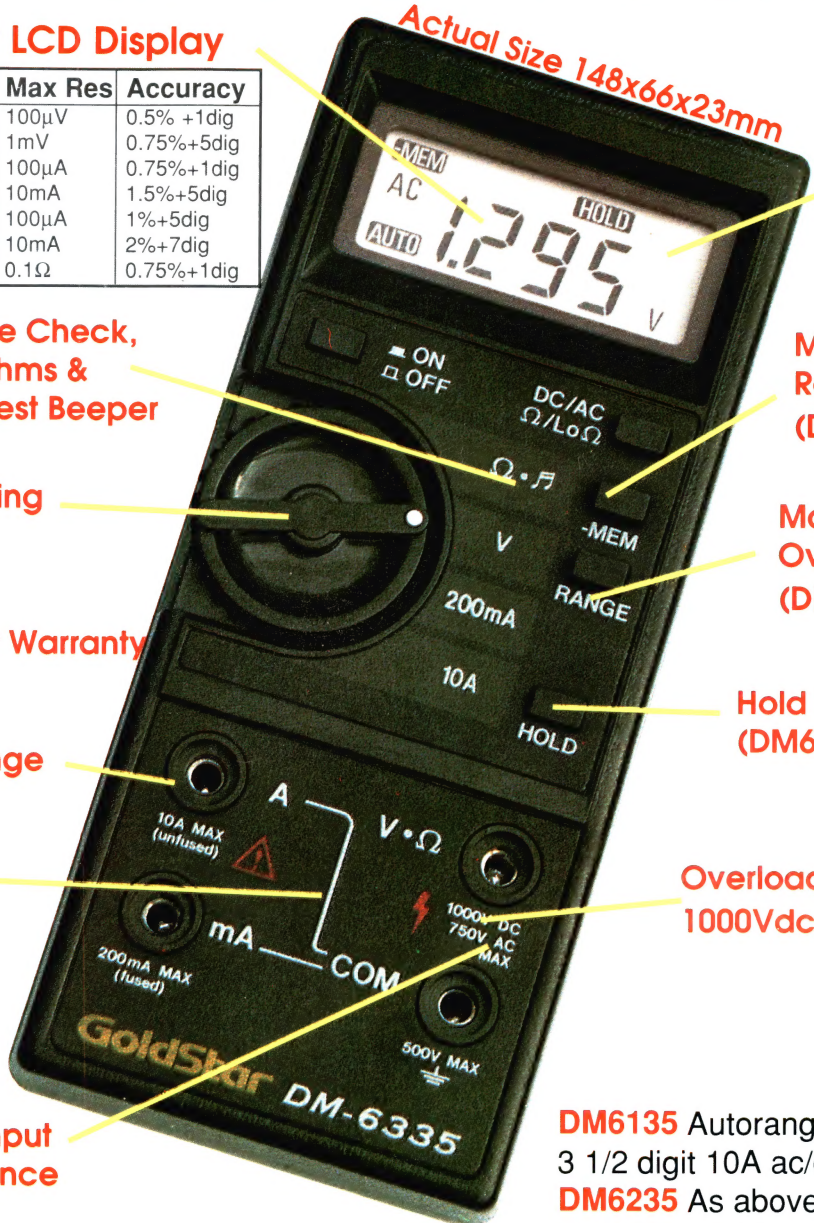

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A RECENT STUDY conducted by the Federal Department of Industry, Technology and Commerce shows that Australia is gaining more scientists and engineers every year from overseas, over and above the number that leave the country each year. The study says that during 1986-87 some 4118 scientists and engineers came to Australia from overseas, while just over 1800 departed, so we gained around 2300. In the four years to date, we gained some 7300 total, including those who returned from living overseas for a period. The study pointed out that the net gain resulting from immigration during 1986-87 was about one-third the total of engineers/scientists who graduated the previous year.

Now, on the face of it, this "brain gain" can't be a bad thing. The study revealed that the greatest gains in the four years to date were, among the engineering professions — in civil, electronic and production engineering, and in science — in biology, biochemistry and geology. But what the study also revealed was that, despite this, serious shortages of electronics, computer and production engineers remained. What this says is that we can't train or import enough engineers or scientists to service the country's needs.

Of course, there are many attractions to becoming an engineer or scientist in Australia. You sacrifice the delights of teenagehood to gain a good pass in the higher school certificate. You then sacrifice up to five, six or seven years at a tertiary institute, living a comparatively frugal existence, postponing the gains and goals your peers are achieving around you, to attain the end goal — that job! Your reward? A comparatively healthy income — slugged by a special tax to pay for your education. Your effort. Your sacrifice. The country's gain. You pay.

Education expenditure is not a liability, it's an investment in the country's future. The proposed tax on graduates is a retrograde step for the country. Some of our celebrated surplus spent on education will reap rich rewards in years to come.

ISSUES

Some production setbacks, combined with the necessary time required to obtain, train and "spud in" new staff in the specialised tasks, pretty well entirely from scratch, when we have limited resources, has taken its toll on issue production. Fortunately, we believe our content and quality has not been sacrificed. In a bid to save slipping behind as we did last year, we have "skipped" the August issue to produce September, this issue. However, 12 issues will be produced this volume, so expect a "special" issue a bit further down the track.

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Using the 555 Timer IC..... 32
Undoubtedly one of the most versatile and popular ICs ever produced. Here's Part 1 of a practical guide on using it and its dual, the 556.

Super VHS — The Full Story 18
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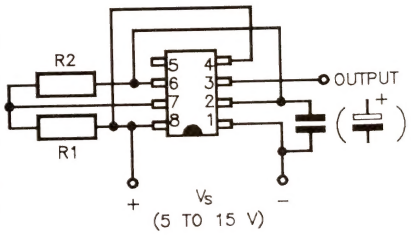
TECHNICALITIES



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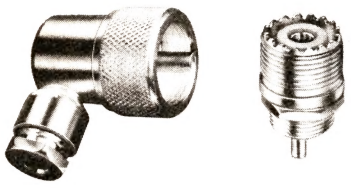

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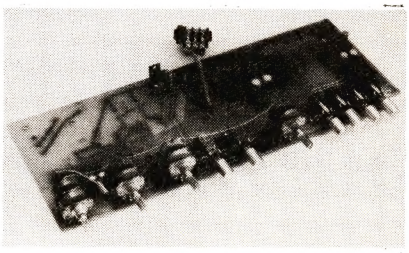

BUDGET STEREO CONTROL UNIT
This low-cost, versatile unit can be built into an existing amp or assembled as a stand-alone unit. It's a top performer, based on the new low-noise op-amp, the LM833. Featuring pushbutton selectors, it has five inputs: phono, CD, tuner, tape and auxiliary, and three outputs: tape, line and headphones.

AMATEUR TELEVISION COLOUR TRANSMITTER
Developed by well-known ATVers Bob Reid VK3AWL and Howard Rider VK3ZJY, this is the ideal project for "getting into" ATV without needing a university degree, mountains of money or expensive test gear! But that's not to say this rig doesn't perform well.

DIY FREQUENCY PREDICTIONS
One of the exciting challenges of working on the HF bands is to "get through" when conventional wisdom or the pundits say you shouldn't. Getting through when conditions are wide open is no challenge at all. But how do you tell when conditions on a circuit are expected to be impossible, marginal or perfect? Leo MacNamara describes how it's done using either of two computer programs. Known as FTZMUF2 and MINIFTZ4, you can use them to predict conditions with much more accuracy and detail than the now-legendary MINIMUF. Naturally, the programs will be made available to readers. As the Sunspots continue on their dramatic rise towards perhaps the largest Solar cycle peak in history, this is just the sort of thing keen DXers will need.

USING THE 555 TIMER, PART 2
The feature continues next month with further coverage on the device's different operating modes and practical circuits to build.

While these articles are currently being prepared for publication, unforeseen circumstances may affect the final contents of the issue.

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COVER
The 555 and a handful of components; simplicity and versatility are the hallmarks of this ubiquitous IC. Pic by David Liddle. Design by Val Harrison.

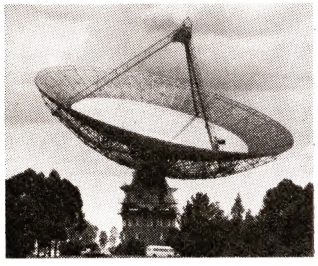
Real Time Clock Module for AT Computers..... 115
Solve that RTC hassle with your AT/compatible with the simply-installed under-$50 module!

SUPERbis Modem Offer..... IBC
Here's a Hayes compatible 300, 1200/75, 1200 and 2400 bps modem for $349 as a kit, $399 fully-built!

NOTE: we have had to hold over the AEM3516 Active Antenna Matcher, unfortunately, for the present until some component supply problems are resolved. The Vintage Restorations column has been held over for space reasons and will resume next month.

Australian scientists discover pulsar with $50 radio telescope

That's right. Radio astronomers working together from the CSIRO Division of Radio Physics, the University of Tasmania and the University of Sydney have discovered a unique pulsar in a group of stars known as 47 Tucanae.



The new pulsar was discovered using the 'big dish' at Parkes, the telescope featured on our $50 note. 47 Tucanae is a tight-knit cluster of about a million or so stars, orbitting our galaxy at a distance of about 15 000 light years.

Pulsars are massive collapsed cores of deceased stars, approximately 10 km across, made up of solid neutron matter. They emit a beam of radio waves, received on Earth as pulses because the pulsar is spinning.

Most pulsars spin at about 100 rpm, or thereabouts. What makes this latest discovery unique is this pulsar is spinning at about *15 000 rpm!* And this energetic little pulsar has a partner – yet another pulsar, rotating at 10 000 rpm. Both of them are also orbiting around unseen objects.

Goldstar instruments

The well known instrument supplier, Elmeasco, has relinquished the distributorship of Fluke instruments and replaced it with a range from Korean manufacturer, Goldstar.

The move follows the acquisition overseas some time back of the Fluke company by the Dutch electronics giant, Philips. Some rationalisation and reorganising of the distribution of Fluke products has been undertaken by Philips worldwide.

Elmeasco has a wide network of dealers and expects to quickly establish the Goldstar name and instrument product line here.

Email merger

A new division of the Email group of companies has been established, employing over 470 people and having an expected annual turnover of more then $50 million dollars, Email claim.

Email Electronics, the new division, is the product of a merger between Email Relays Division and Electronics and Petroleum Equipment Division. The new division will become part of Email's Industrial Products Group.

The new division now controls the two spheres of influence that the previous two companies looked after. Therefore Email Electronics is responsible for the manufacturing and distributing electronic controls, electrical relays, telemetry systems, alarm systems and related equipment, petrol pumps, bulk fuel dispensing equipment and related computing and control equipment.

While continuing to maintain, and expand its existing manufacturing facilities at Kilsyth and Huntingdale in Melbourne, the merger is said to be designed to give Email a stronger rescource base for the engineering and manufacture of electronic products and increase their exporting and servicing power, according to the company.

New CSIRO institute

The Director of the CSIRO has formally launched a new CSIRO Institute of Information and Communications Technologies (IICT).

The new institute will embrace three main divisions within the CSIRO, namely; Information Technology, Mathematics and Statistics, and Radiophysics.

Also in the institute's sphere of influence is the CSIRO Office of Space Science and Applications (COSSA).

The institute hopes to "be an Australian leader in strategic research on information and communications technologies for the benefit of Australian industry and for the national interest", claims Dr Bob Frater, director of the IICT.

More information is available from **Dr R. H. Frater, Director, IICT, 105 Delhi Road, North Ryde 2113 NSW. (02)887 8222.**

Award for image sensor development

The British Royal Television Society's 1988 Geoffrey Parr Award has been presented to Philips Research Laboratories in recognition of their R & D work on the frame transfer solid-state image sensor.

It is the Society's highest award for engineering; the sensors are used in in Philips portable and studio CCD colour cameras

Euro-SAT Standard agreed upon

Major representatives from Europe's consumer electronics industry have wholeheartedly agreed on the specifications for the new "EUROCRYPT" Scrambling and Conditional Access System. The new system uses the MAC packet system for satellite transmissions.

The agreement is the fruit of many months of negotiations between the 'ANGLO-NORDIC' and 'EUROMAC' groups; two major industry associations in Europe. Also, the European Broadcasting Union has been instrumental in establishing the new standards.

The complete technical specifications for the EUROCRYPT system will be released in the following months and volume delivery of products to the market in Europe will commence from mid-1989 onwards, co-inciding with the Pay TV services on the dawning medium and high-power satellites.

It is claimed that EUROCRYPT will introduce many advantages to both consumers and supplier of the programs.

Customers will need only one satellite receiver to view programs from all of the new European satellites, and program providers are ensured their programs and valuable customers data are protected.

A consortium plan will shortly be announced in Europe between Philips, Thomson and Nokia-Salore.

High-temp. superconductor shows promise

A new high temperature superconductor developed by Fujitsu shows promise as a material for use in large-scale ICs as the company has managed to spin it into a single-crystal film just one-third of a micrometre thick.

Being a single-crystal material, it can carry higher currents before losing its superconductivity.

The new superconductor is a compound of bismuth, strontium, calcium, copper and oxygen.

Aust-USSR space venture for 1992

Australian electronics manufacturers will be designing and building equipment for "Radioastron", an international satellite venture to be launched by the USSR in 1992.

It's a radiotelescope which will be used in conjunction with ground-based telescopes such as the new Australia Telescope at Culgoora, so that the instruments can use a technique known as very long baseline interferometry (VLBI) to map galactic radio sources.

The CSIRO's Division of Radiophysics was invited by the USSR to participate in Radioastron. The Division is responsible for the Australian input to the project through the design of the 1.6 GHz (L-band) re-

THE INNARDS OF A SLICE OF SILICON

This is what a piece of silicon looks like at the atomic level; you're looking at a chunk just 200 atoms across.

The screen at left shows a contour map of the piece of silicon, while the screen on the right shows the same sample imaged sideways.

The instrument used to obtain this smaller-than-ant's-eye view is called a "Scanning Tunnelling Microscope", or STM. The instrument was developed by W.A. Technology of Cambridge, in eastern England, and is capable of resolving individual atoms on the surface of conducting materials and provides data on their electronic properties.

The basic principle of the STM, pioneered by two IBM scientists who were recently awarded the Nobel Prize, is that if two conductors are held about one nanometre apart, a small current can "tunnel" across the gap between them.

The STM could be used to write circuits on a substrate with line widths on a scale of 100 angstroms, 100 times smaller than those of conventional one micron chips used today. It could be developed to a stage where it was possible to move single atoms like bricks in a building, to modify the structure of materials.

ceivers and its role as host institution of the Australia Telescope.

Two major contracts for the project were awarded by the CSIRO Office of Space Science and Appplications last June, British Aerospace Australia being selected to develop the L-band low noise receivers and amplifiers.

The Radioastron project is being undertaken as part of Australia's formal cooperation with the USSR under the new Space Science Agreement signed by Mr Hayden, the Minister for Foreign Affairs and Trade, late last year.

The bismuth group of semiconductors are a Japanese discovery, announced earlier this year by Hiroshi Maeda who heads a team at the Institute of Metallic Material Research at Tsukaba.

Bismuth compounds are said to be easier to turn into practical devices. Fujitsu said they employed newly developed equipment to grow the crystal.

They plan to use them to build a superconducting quantum interference device (SQUID) which could be important in ICs of the future.

'NoNoise' rescues old recordings

Works by Ravel and Prokofiev recorded in 1928 and considered beyond rescuing by electronic processing have been re-issued by Philips on CD after being salvaged by a new computer audio processing system called NoNoise.

Developed by Sonic Solutions of San Francisco, the system can remove surface noise, clicks and scratching sounds from old recordings on tape or disc.

A digital system, NoNoise converts the original sound into digital code which is then stored on hard disks with a total capacity of 1400 megabytes.

The system identifies transient noise, removes it, then replaces the "gap" with a synthesised section of sound.

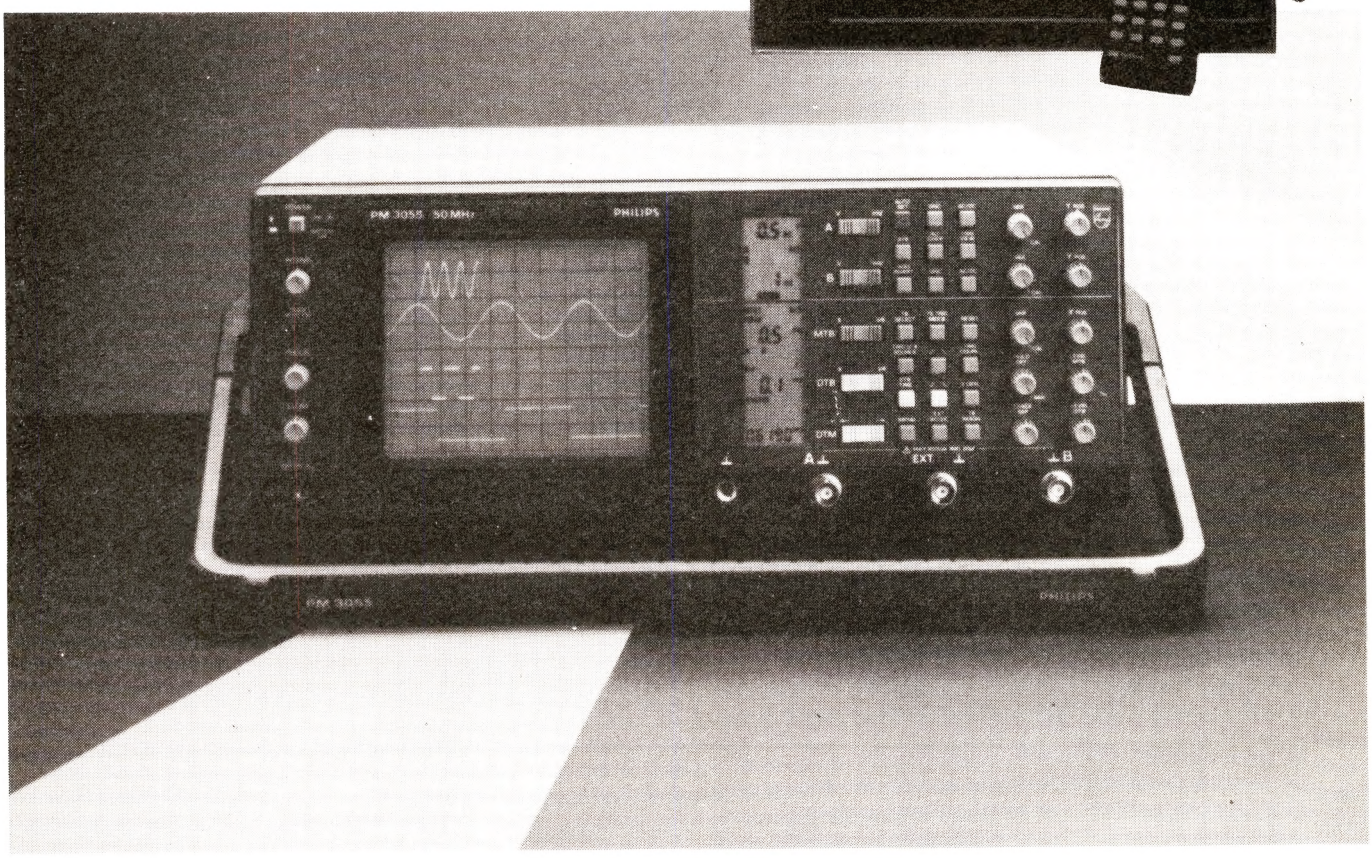
To remove background noise (hiss), the system analyses the sound from a short length of recording where there's no music, then splits it into 2000 separate frequency bands, measuring each one to establish a "fingerprint" of the noise.

The system then splits the music recording into 2000 bands also, and compares them with the fingerprint. When noise dominates the music, the system deletes it. When the music dominates, it's left alone.

It's not fast, so it won't work in real time. One hour's recording takes some 8-10 hours of processing!

Soon we'll know, no doubt, what Emile Berliner *really* recorded on that first disc he pressed! Did Edison utter the first words recorded on cylinder, or his assistant? Who coughed in the background?

SONY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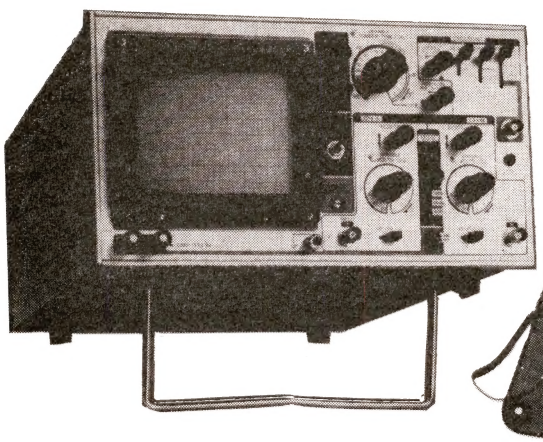

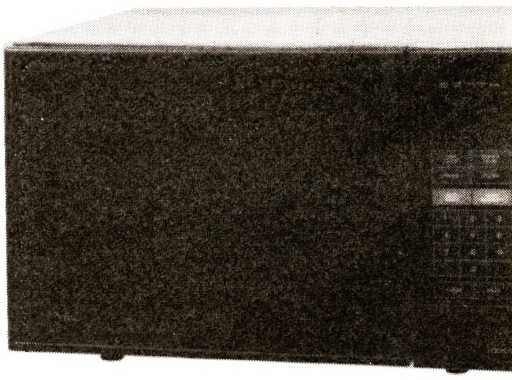

Fabulous prizes to win in our third birthday contest series!

What a haul! No matter what your interest in electronics, there's got to be several prizes in our great contest series to attract you.

OUR FIRST BIRTHDAY contest series proved extremely popular with readers. In five contests, we gave away six prizes worth over $6000. The contests ran over three issues and we got mountains of mail. We gave ourselves a few headaches judging it!

This year, for our third birthday, we're repeating the exercise – only we've got *more* prizes to give away – worth over $8000! How's that – it's *our* birthday and *we're* giving away the prizes! Eight firms have generously contributed equipment for the prizes: 3M, Dick Smith Electronics, Eagle Electronics, Elmeasco, K.C.C., Kenwood and Philips Scientific & Industrial. There's a total of ten products being given away in seven contest.

The contests this year are constructed in much the same manner as our 1st Birthday contest series. You have to answer a few pertinent questions on the prize, an "interesting" question on the prize's technology or technological background and then write us a little essay. Nothing too difficult there!

Enthusiast, engineer, captain or carpenter – get amongst this lot! You may enter any or all of the contests (hang it, go for broke!), and you may send as many entries as you wish. You can photocopy the contests, rather than cut your magazine, just provided you send an *original* page number of each contest with each entry, cut from an issue in which the particular contest appears. Give yourself more chances!

The prizes

Philips Scientific & Industrial Division donated a PM3050 50 MHz dual-trace oscilloscope for a prize in 1986 – and this year they're donating another! This time around its the upgraded 60 MHz model, PM3055. *And* they're throwing in a pair of 100 MHz x10 attenuator probes. This prize is worth around $2700. Fantastic! This CRO benefits from microprocessor control and has a number of unique features. It's ideal for general service and R&D work and is especially suited to working with video and TV equipment owing to its sophisticated timebase facilities.

Dick Smith Electronics has donated four of their great kits – so, if you're a dyed-in-the-wool enthusiast, you'll go for this. Their prizes are:

The K 6315 Teletext Decoder;
The K 6319 Teletext Tuner;
The K 4003 IR-remote Stereo Preamp;
The K 3437 1 GHz Frequency Counter;

The kits come with full instruction manuals and all parts, including the cases (except for the Teletext tuner, which installs inside the Teletext decoder). No doubt, as an enthusiast, you'll appreciate the utility of the 1 GHz Frequency Counter, while your family will appreciate the Teletext equipment and the IR-Remote Stereo Preamp. That lot should keep your weekends busy for a few months!

The Minnesota Mining and Manufacturing Co., better known as 3M, weighed-in with a static dissipative field service kit. Ideal if you're in servicing, or if you work with products or devices sensitive to static damage. Handy to have around, it could save you heaps, as well as saving heaps of hassles.

Elmeasco, the well-renowned instrument company, has *also* donated an oscilloscope – one from their Aaron range. This is the Model BS-601, worth $890, an ideal unit for general use – fault-finding, signal tracing, servicing, development work, etc. It features a component tester that can check both passives and semiconductors, giving an on-screen display characteristic of the device under test.

For the communications enthusiasts, Kenwood Electronics Australia donated one of their new wideband scanning receivers, the RZ-1. Sophisticated, but simple to use, it's a top performer that comes in such a tiny package it's ideal for mobile use, but acquits itself equally well as a "base" station monitoring receiver. It covers from the AM broadcast band through to 905 MHz, without break, and provides FM as well as AM reception. And we gave it an enthusiastic review in our June issue. This unit is worth over $1000!

Local mains filter manufacturer, K.C.C., has donated one of their top-line LF-4 "Squeeky Clean" Mains Filters. This features *four* filtered outlets and is ideal for keeping mains-borne "hash" from creating interference in communications receivers, etc, and keeping equipment- generated has from getting back down the mains. So, we've teamed it with the Kenwood RZ-1 so you can operate it from the mains, knowing you've eliminated sources of interference there.

And here's something for *everybody!* Eagle Electronics of Adelaide has donated an NEC Microwave Oven. We all have to eat! So, win this and you can spend less time slaving over a hot stove and more time slaving over a hot soldering iron!

Righto! Now, turn through the pages of this issue, seek out the contests and go to it! Who said it? – you've got to be in it to win it!

Rules

The contest is open to all persons normally resident in Australia or New Zealand, with the exception of the members or families of the staff of Australian Electronics Monthly, the printers, Offset Alpine, the companies donating prizes and/or associated companies.

Contestants must enter their names and addresses where indicated on each form. Photostats or clearly written copies will be accepted, but if sending copies you must cut out and include with each entry an original page number and month cut from the bottom of the page of the contest. This contest series is invalid in states where local laws prohibit entries. Entrants must sign the declaration, accompanying each contest, that they have read the above rules and agree to abide by their conditions.

The winning entry will be drawn by the Editor, whose decision is final; no correspondence will be entered into regarding the decision.

Winners will be notified by telegram the day the result is declared and the winner's name and contest results published in the next issue of the magazine in which it's possible to do so.

Send all entries to:
AEM Third Birthday Contests
1st Floor, 347 Darling Street
BALMAIN 2041 NSW.

CONTESTS CLOSE 31 OCT. 1988

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More on the Status Monitor

Dear Sir,

I am a little concerned about the subject raised by S. Overton of Auckland, NZ, in his letter published in the April edition of AEM. The problem he experienced with the AEM6504 Power Amp Status Monitor is of much interest to me because I am currently building a pair of these monitors for installation in my Series 5000 Power Amp.

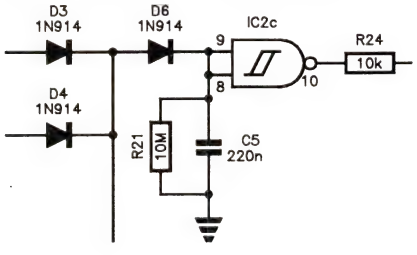
In your reply to S. Overton, you suggested that the Status Monitors should be used in conjunction with the AEM6505 Surge Limiter. Is this so in all cases? Can the Status Monitors be installed successfully in the 5000 Power Amp? If so, do you have any advice which may assist a relative novice in performing this task? Any help that you can offer in this regard would be much appreciated.

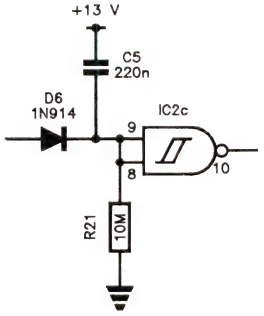
I enjoy your magazine for the information and projects therein, keep up the good work.

B. Morrison,
Kirrawee, NSW

*The Surge Limiter does not **have** to be used with the Status Monitors. The Surge Limiter reduces the in-rush current to the power supply caused by the low initial impedance of the smoothing capacitors.*

The Status Monitors, used on their own, will provide both de-thump and fault protection. However, as published, there is an error on the pc board. C5 should actually connect from pins 8-9 of IC2 and the positive supply rail, NOT to earth. Cut C5's earth track and link it to pin 14 of IC2. A correction on this was published on page 7 of the July edition.





On reading the Circuit Operation again, it seems D6, R21 and C5 were meant to be connected to pin 13 of IC2d, rather than at the inputs of IC2c.

You can certainly use the 6504 Status Monitor with the 5000 power amp. They are hooked up in the same way as shown for the 6000 power amp (page 50, September 1986 issue), and it is recommended you use the 6505 Surge Limiter. Either way, you will need to supply an ac source of 15-0-15 volts. If the Ferguson PF4361 power transformers used in your 5000 amp have the two extra 15 V windings, use them. If not, you'll have to fit a small transformer somewhere inside the case.

And again

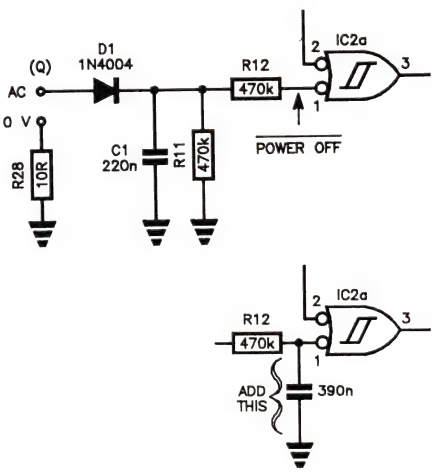
Dear Sir,

I too have experienced S. Overton's problem with my AEM6504 Power Amp Status Monitor. The problem was that the relay would briefly turn on just after power was applied.

I solved this problem (empirically!) by connecting a 390n capacitor between pin 1 of IC2a (i.e: R12) and earth. Perhaps you could pass this information on to Mr/s Overton, and also explain why this cured the problem.

Congratulations on an excellent magazine.

W. Gout,
Brisbane, QLD



I suppose that's another solution, but it's more in the way of curing the symptom rather than the fault! You could safely remove C5.

The 390n capacitor appears as a sort circuit at the moment of power up and will hold pin 1 of IC2a low for some seconds while it charges via R12. Pin 2 of IC2a is low following power up, so the output of IC2a, pin3, will be low. This drives pins 8-9 of IC2c low and its output, pin 10, high, turning the relay on. When the 390n capacitor charges to the gate threshold of IC2a, pin 3 of that IC goes high, driving pin 10 of IC2c low and the relay de-energises, connecting the speakers.

The turn-on "bang" of the power amp, or almost any power amp for that matter, occurs because the power amp's dc conditions are not established until the supply rails reach a reasonable value, so a substantial output dc offset will arise, with some contribution caused by the fact that each supply rail will not rise at the same rate.

Data on old IC

Dear Sir,

I am in need of assistance from either yourself or a kind reader.

I require the wiring diagram of a 25 W hybrid power amp IC, model number SI1025E. Any assistance in this regard would be much appreciated.

How about a circuit of a true Class A Power Amplifier? I am convinced there are many readers that would like to upgrade to the best quality.

B. Whitfield,
Seacombe Gardens, S.A.

*Unfortunately, the SI1025E seems to be a very old Sanken device. It was discontinued in **1974!** The only details I could round-up are from the same series of devices SI 1020/SI 1030, obtained from Stewart Electronic Components in Melbourne, who stock a range of Sanken devices.*

Thanks for the suggestion on the true Class A power amp project. We might take a look into that.

Ultra-fidelity Preamp extension

Dear Sir,

I would like to say that, after a period of not buying your magazine I have bought the last few issues and have been impressed with them. I stopped after your price jumped following the inclusion of Elektor, but now the other two have more or less fallen into line with you and now we have a new one!

Four magazines gets a little expensive per month and I have to consider the projects in a particular issue and their value to me.

In 1985 you published the 6010 preamp/control unit and stated there would later be an add-on unit, tone controls, headphone amp, etc. As far as I know this has never eventuated. Can you tell me if and when it will, as I built the 6010 some time ago? You also said in a personal reply once that an FM tuner was in

the wind, but so far no FM tuner. Looking forward to your reply.

Paul Gee,
Orient Point, NSW

Many thanks for the encouraging remarks. Now that we've discontinued the Elektor material, increased the number of pages AND dropped the cover price, no doubt you'll find AEM even MORE attractive each month!

Regarding the mooted "Preamp Extension", I have given a specification to our current project team, one of whom specialises in audio and who worked under Richard Small (of "Thiele & Small" fame) for some years. It should eventuate in due course.

An FM tuner is still "in the wind", but a "front end" remains the problem. Commercial units of ***adequate*** *quality just aren't available and we're attempting to design one that only requires minimal, non-critical line-up. A tall order! However, it is also under active consideration.*

Amplifier update

Dear Sir,

Having already built the 5000 pre-power amp and the Vifa 3-way speakers, I feel its time to update the amp.

I am looking at the 6000 amp, or activating the Vifa speakers. I have some questions: for CD only, can I get away without a preamp or does the impedance pose a mismatch? For the active speakers, does it really require the 6000 modules or can something like the old ETI480 100 watt modules be used without too much loss in performance?

Which would be the best setup, active or passive? And just how good would it be compared with commercial products?

Many thanks for your help.

David Love,
Underdale, S.A.

Whether you "activate" the 6103 speakers or build the 6000 power amp depends on a few factors you haven't said anything about in your letter.

If you are considering activating the speakers, then I would assume cost is not a major consideration. Active loudspeakers almost invariably perform better than their passive counterparts as the amplifier exerts more control over the driver.

For this exercise, the 6005 100 Watt "U-F" Topology Module would be suitable for the bass and mid-range of each speaker, while the 50 watt 6500 module would suit the high frequency drivers. The 6503 Active Crossover is then the natural choice for the crossover. As a "worked example" of this application, see the AEM6112 Active Two-Way Loudspeaker in our November 1987 issue.

As for the ETI480 modules, they just don't have the noise and distortion performance now necessary with today's digital sources and high performance speakers.

You can obtain suitable component values to suit the required crossover frequencies by reference to Jack Middlehurst's series on ***Practical Filter Design – Without Fears or Tears*** *that ran from the October 1987 issue to the June 1988 issue. The design programs are available on a 5.25" floppy through our software service for $65 the complete set. They run under PC/MS-DOS on an IBM or compatible.*

All that notwithstanding, I think you'd find the combination of 6000 power amp and 6103 loudspeakers very satisfying. Note that the 6103s are now marketed by Scan Audio, following some improvements, as the Vifa SA-100 Loudspeakers.

If you wished to dispense with a preamp and use your CD player alone, then its output should provide adequate drive to the power amp or active loudspeaker setup. Most CD players are rated to deliver 2.0 V output, while the 6000 and 6005 amps each have an input sensitivity of 1.2 V or better for full output. Input impedance should present no problem.

Full kits of the 6000 power amp, including all metalwork, are available from Eagle Electronics in Adelaide who, incidentally, in keeping with the "ultra-fidelity" criteria of the design, supply quality polypropelene and polyester capacitors and metal film resistors with these kits. A number of suppliers stock the 6000 or 6005 modules, and the 6500 modules are widely available.

Happy SUPERbis Modem enthusiast

Dear Editor,

my SUPERbis modem is working (it worked first up – do I get a free tee-shirt?) and I thought a few words from a successful constructor may allow others to profit from my experience and save some time and confusion. My comments generally are about the things not explained in the series of articles.

Assembly of the project was spread over four days with about two to three hours being spent each day. I was determined to get the job done right in the first place and adopted a routine of soldering a component then taking time out to inspect my work. The board is *very* crowded so I found that the Magi Lamp (those big ugly magnifying lens-and-lamp gizmos!) was mandatory. So, too, was a very fine tip on the soldering iron and extremely thin solder.

It was important to keep the iron at a constant temperature and to keep the tip particularly clean. I confess to the use of a solder sucker on several occasions when sloppy work caused the solder blob to bridge between pads.

The board layout has many plated-through holes that are positioned very close to solder pads and I needed to be careful that solder stayed on the pad being soldered and didn't bridge to a plated-through hole.

The board is of fine quality but does not appear to tolerate a lot of desoldering or excessive heat. Any constructor attempting to remove a component should approach the task with great care.

Several years ago a friend working at a solder factory gave me a small tin of solvent that I can brush onto pc boards to remove resin, etc. This stuff sure works well (Editor – maybe a story here?) removing the resin and any stray hairs of solder not properly adhering to the board.

Each hour or so I world brush this solvent onto the board and it would really clean the work nicely.
Afterwards, it was easy to inspect the work with the Magi Lamp and look for (and repair) suspect soldering.

Now for some specific construction comments, based on my experience.

1. The plastic bolt and nut. This is a goodie. I didn't use it and expect it is somehow a reward for the few resistors and capacitors not in the kit and that I had to find in my junk drawer. Maestro maybe had lots of these plastic items and decided to give these away to unsuspecting kit buyers. Two small screws required to hold the pc board to the case were not in the kit but I found a couple the right size in my faithful bottomless junk draw.

2. The two yellow strips of sheet steel: These go on the outside of the plastic case to dress it up. The two plain black plastic face plates go to the rubbish bin – perhaps companions to the plastic nut and bolt (Item 1, above).

3. Don't forget the strap between pins 2 and 4 of the LM386 (U21) op-amp.

4. The speaker is too loud (personal preference) and R48 (10k) was changed to 4k7. I also installed C19 (1 uF). These changes certainly made the modem more socially acceptable in my "computer hostile" household (aren't they all?). The software command to alter the speaker volume (ATL0 – Soft ATL1 – Loud) produces only a tiny change. The speaker quality is excellent and incoming audio is very good.

5. I installed a reset switch (momentary contact pushbutton) to the reset pads located on the board. The switch was positioned in the top left corner of the back plate. There probably is no firm reason why the switch should be installed but since provision was made on the board to fit one, I decided to do it at the time of construction. Fortunately, I ▷

had a few DIL circuit board pins and connectors in the junk box and made a nice clean job of it.

6. Capacitors C21 and C22, shown in the text as 15 pF, are actually 33 pF.

7. Resistor R35, shown in the text as 4k7, is actually 10k (see the circuit diagram).

8. The regimen concerning various "AT" test codes were not supported by the EPROM supplied with my kit. I understand from Maestro that these features of the prototype will be available in later upgrades of the EPROM.

9. The location of the jumper block for SW2 is not explained in either the text or the Maestro User Notes. I deduced from the circuit diagram that the jumper should be positioned to short out the top two of three pins.

The modem doesn't work without the jumper in place and incorrect fitting of the shorting block would connect Vcc (5 V) to pin 26 of the EPROM.

10. The supplied heatsink fits to the 7805 (U23) and it is important to "lock" it with glue to the bodies of the adjacent capacitors, C2 and C3, so it can't slide sideways. If it moves towards the top of the board it will short against the pins of the on/off switch, SW1. The 7805 sure needs the heatsink since it gets very warm.

11. I am colour blind to some shades of red and found it difficult to see if the Power LED was on or not. To cure this, I changed R12 to 220 Ohms to increase the brightness to a level that I can see. I may later change the LED to another colour.

12. The S registers on my modem do not have some of the default values nominated in the Users Manual; S7 shows 45 (default 40), S9 is 4 (6), S14 is 10, and S22 is 86 (118).

13. I was unclear about the required testing methods outlined in the article and formulated a system of my own. With my multimeter, I verified that each of the regulators were producing the required voltages and then checked that all sockets had the correct voltage levels at the prescribed pins. Only after this process did I have the confidence to install all chips and connect the unit to the computer.

14. After three days of extensive use, the ac power pack stopped working. A telephone call to Maestro had a replacement in my hands the very next day (certainly couldn't argue with the service)! I was concerned that Maestro had a bad batch of power packs but they assured me that my problem was not typical and was isolated to a handful of units.

15. I am a bit peeved that Part 4 – "Controlling the Modem" will only appear in AEM well after I have constructed the modem. All "AT" commands are documented in the User Notes that accompany the kit. Roy Hill, however, has a conversational style of presentation which I am sure will be more enlightening than the definitive listing of the command functions.

16. The Super8 chip gets VERY hot and I am concerned about this. By the time this note reaches you, I will have purchased a heatsink to glue to the top of the chip. As the chip is located between the two expansion bus ports on the board, I have decided a commercial heatsink rather than a homemade one from
scrap aluminium is required so that it won't interfere with future access to the bus.

The kit included a plastic presentation folder with details about FORTH, programming notes, parts list, construction notes, and particularly useful – LARGE copies of the circuit diagram and component overlay. These big copies were pinned to the wall and regularly consulted. Other kit suppliers please note!

Deficiencies? None of great consequence. Perhaps, Mr. Editor, we could have a clearer, larger reproduction of the photograph on page 85 of the June edition.

Final judgment? The kit is excellent and most complete. There were several errors with the supplied instructions and magazine text, but considering that the magazine story and kit instruction sheets would have been created with prototypes, inconsistencies were inevitable. None were so serious as to cause severe problems.

At $349, the kit is a *bargain*, although perhaps, the bigger bargain is the fifty bucks to get it fully built. Then again, I would rather have assembled it myself. And I could not fault the support – most helpful.

The future? Please, Mr. Editor, don't be concerned with jibes about Australian "Modems" Monthly (*Letters*, June issue).

The leading edges of electronics are in computers and communications. More projects about these subjects are germane to the purpose of your publication.

Please request the Darling brothers to expedite development of their next project or modem upgrade. I, for one, will be waiting – eagerly.

M. S. Rychter,
Dover Heights, NSW

Thank you very much for your complimentary remarks and for sharing your experiences with us on assembly of the AEM4624 SUPERbis Modem kit.

Roy Hill wrote the article series on the modem by constructing a kit under supervision of the Darling brothers. Some small revisions were subsequently made to the final product following early field experience.

I'm sorry we were unable to "jam" all the articles into one or two issues so that you had it all before finishing assembly of your modem. The popular appeal of the project was immediate and we actually received orders literally within hours of the May issue going on sale! And we didn't advertise the modem kit/built-up offer until the June issue! Once kits were available, assembly inevitably preceded publication. It's not really possible to do everything at once!

Your assembly strategy pretty well guarantees success. A pity more constructors don't adopt similar methods – there'd be fewer problems with kits that "didn't work".

Regarding the photograph on page 85 of the June issue, yes, I agree that reproduction here could have been somewhat clearer. At the time the June issue was produced, we had a new production camera (which is used to size the pictures and illustrations, and to break up photographs into dots for the printing process), new staff (Rick Jones – take a bow!) and we were still adjusting the process to take the characteristics of the printing press into account. Your comment is well-taken – knowing our failures and faults, we can improve in future.

Roger Harrison

Electric fence tester

Dear Sir,

In reading one of your magazines I came accross an article for the construction of an electric fence unit (for stock control etc.) of ~5kV.

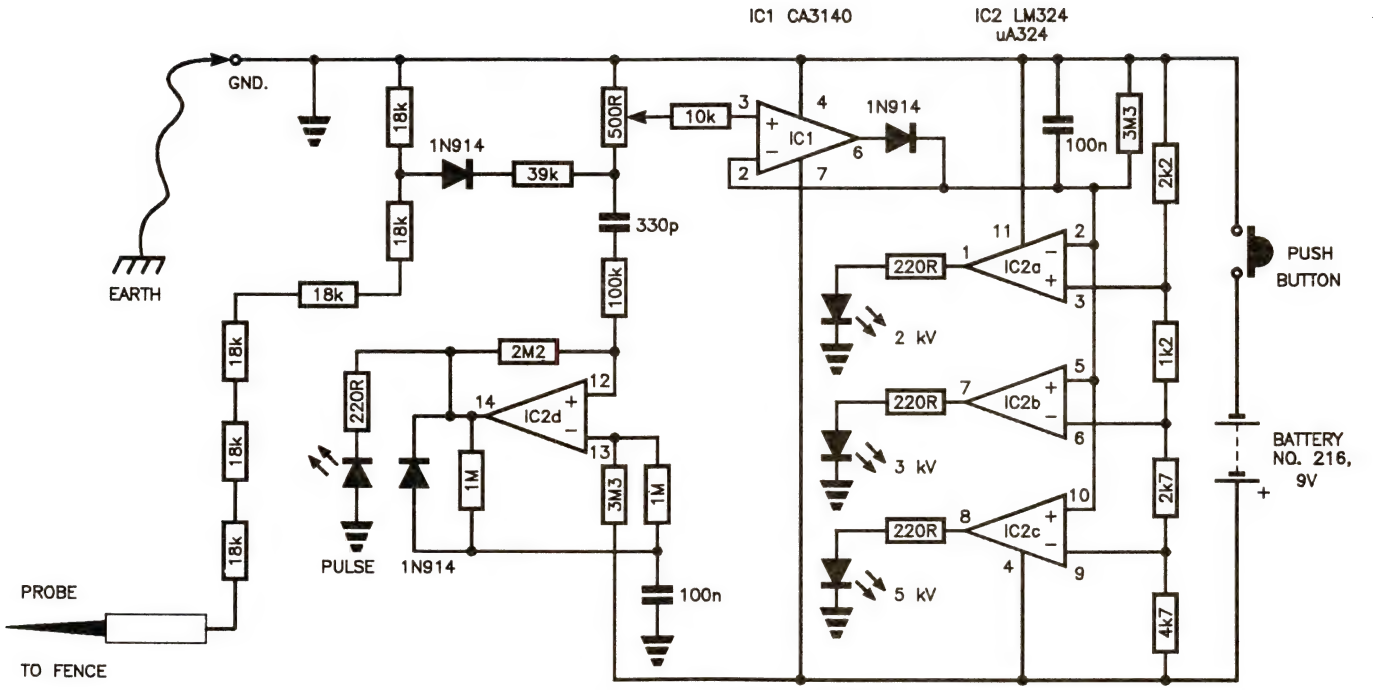
What I need is the circuitry of the unit for testing of an electric fence. Can you let me know the month and year you might have had a plan available? Or perhaps you may have the plans of an 'electric fence tester' that could be sent to me at cost?

A M Pattison,
Waitakere, NZ.

No problem! The circuit reproduced here comes from the designer of the AEM9502 Electric Fence Controller published in the October and November 1986 issues, Graeme Teesdale.

The unit has a well-insulated probe which is touched on the fence, and a ground connection which is hookep up to a stake poked in the ground. The high voltage pulses are divided-down by the string of 18k resistors to a manageable level. An LM324 quad op-amp, IC2, is used to drive various indicator LEDs. IC2d shows a pulse has been received by lighting the "PULSE" LED.

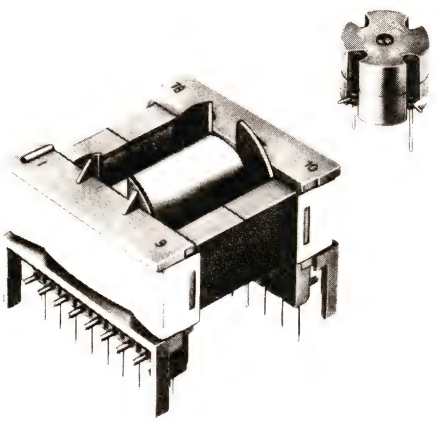
IC1, a FET-input op-amp, serves as a sample-and-hold, charging the 100n capacitor on its output to a level prop-



ortional to the amplitude of the incoming pulses. ICs 2a, b and c then light the three LEDs marked " 2 kV, 3 kV, 5 kV" accordingly.

The unit may be operated from a No. 216 9 V transistor radio battery.

It would be wise to construct it in an all-plastic jiffy box and to use a well-insulated hook- or clamp-type probe.



Losses in high frequency inductors

Dear Sir,

May I firstly congratulate you on your latest magazine (April). The NOVIX board looks amazing – have you published any tutorials on FORTH? The review of EHT's new 1 kW/channel amplifier was also good. I found it intriguing how they obtain consistent and repeatable results with the simple overload indicator they use – or is it just short circuit protection?

I have a small problem. The drawing lamp I use keeps blowing those expensive daylight-blue light globes – I like to imitate working at the beach! Another journal published a light bulb saver circuit some time ago, which fits behind a wall plate. Unfortunately, there isn't enough room in my lamp to fit such a circuit – besides, it gets hot! How would a capacitor connected across the switch do – to keep a trickle current flowing through the bulb to keep it warm? Do you have any bright solutions?

I am an electrical engineering student at UNSW. During my work experience, my project was a series-resonant dc-dc converter. It was based on the concept of switch-mode. However, it used a resonant switch which shaped the current through the switch (a FET) to look like a sine wave. The aim was to build a very clean power supply which was very efficient. The best we obtained was 78% efficient, using a switching frequency of 100 kHz – however we expected a higher efficiency than this. The losses were traced to the transformer – the FET needed no heatsink and the other components were an air-cored inductor, silver-mica capacitor and a Shottky rectifying diode.

My request is this: I never quite got the hang of inductor and transformer design. Oh, I can wind a given inductance given the inductance factor, but I don't understand things like calculating loss; how much flux to allow for in a transformer core; what is the optimum core size (I understand that too small a core leads to saturation, too large leads to energy-per-unit-volume losses); how to calculate the air gap etc.

I don't want a simple reference to a journal or dry text book. The lecturers at uni aren't much help either, I'm surprised to say. So please, could you – in that down-to- earth and lucid style that I find so easy to read – set us straight regarding high frequency inductor and transformer design? I especially need help in designing transformers which will take large peak currents which are sinusoidal without incurring losses. The power levels I'm interested in are 2-10 watts, but I'm sure the general principles apply to larger units.

And for all of us raving hi-fi nutheads – could we have a pure class A amplifier to play with? Even a headphones-only job? OK, OK, so you refuse – then please tell us instead how to design one. You know – biasing of differential input stages to minimise noise and maximise bandwidth, design of temperature-stable current sink for the output stage etc.

How about a really radical feedforward amplifier? What happened to the nested-loop design I saw somewhere awhile back?

Looking forward to your reply.

Fabio Barone,
Mascot, NSW

Blowing your lamps, eh? Well, we have just the project for you! It's the AEM5506 Lamp Saver, published in the October 1986 issue. Back issues currently cost $4.00, post paid. The project is quite small and should be well-suited to your application.

Transformer design is part art, part science, part engineering – and it's a positively huge field. It would possibly require something akin to the length of Jack Middlehurst's series on Filter Design to do it justice and impart useful, practical information. A tall order, but not impossible. Keep reading!

There's no doubt about the interest in audio – and we have plans in hand to tackle a few articles along the lines you suggest. Once again, keep reading!

WHY BUY IT?

BUILD IT YOURSELF & $AVE!

Building your own saves you money – especially at the low, low prices of our amateur & related kits this month (see below). But there's more reasons to "roll your own" than ***just*** to save money...

- You'll keep (or maybe regain?) those construction skills you had back in the good ol' days – when all there was available was to do it yourself.
- In these days of "black boxes" it's to easy to lose those important – perhaps elementary – skills such as soldering technique, component dress, wiring, even component identification!
- You'll be able to enter those "home brew" competitions that used to be so much a part of our hobby. Today they're all but forgotten in many instances.
- You'll get the piece of gear – test equipment, transceiver, amplifier, whatever, far sooner than having to wait until you've saved for it.
- Perhaps most importantly of all, you'll be proud to say "I built it myself!"

BIG SAVINGS THIS MONTH ON AMATEUR & RELATED KITS:

UHF Amateur Transceiver
The ideal way to get onto 70cm.
Cat K-6300 Was $249.95
THIS MONTH: $199

40/80CH Upgrade Kit for UHF Transceiver
Doubles the number of channels you can access. Cat K-6301
Was $12.95 **THIS MONTH: $5.95**

70cm Preamp
Not just for the kit transceiver: get a few more dB out of any commercial receiver too — and cheap! Cat K-6306
Was $21.95 **THIS MONTH: $9.95**

UHF GaAsFET Preamp
When you really want performance, try this beauty! 13dB gain, includes full tx/rx switching. Cat K-6309
Was $129.00 **THIS MONTH: $99**

UHF Power Amp
Extra oomph out, too: 50W ish from 2W drive! Includes carrier detecting switching. Cat K-6307 Was $279.00
THIS MONTH: $199

UHF Wattmeter
The inexpensive way to keep your 70cm station up to scratch. Cat K-6312
Was $49.95 **THIS MONTH: $39.95**

2m Amateur Transceiver
Why not make a pigeon pair? Covers full 2m band . . . a great "big time" project for novices (needs fair level of technical skill). Cat K-6308
Was $249.95 **THIS MONTH: $199**

2m GaAsFET Preamp
Like its 70cm brother, it will put some SIG into your signal! Cat K-6311
Was $129.00 **THIS MONTH: $99**

Need A Supply?
Matching 13.8V power supply for VHF or UHF transceiver. Cat K-6310
Was $49.95 **THIS MONTH: $39.95**

How About A Linear?
Perfect for the kit — or handheld, etc. 100W out from 15W in (40W from 2W). Cat K-6313
Was $299 **THIS MONTH: $249**

Or A Power Meter?
VHF Wattmeter is easy to build, a must for your 2m station. Cat K-6316
Was $49.95 **THIS MONTH: $39.95**

And Just In Case You Have Too Much . . .
Attenuate it! The 50 ohm attenuator kit gives you up to 63dB attenuation in 1dB steps from 50 to 500MHz.
Cat K-6323 Was $79.95
THIS MONTH: $49.95

HF Transceiver Slashed, Too!
Covers 500kHz of HF, with 30W PEP output. As supplied covers 80 metres, upgrade kits below give you other bands. Cat K-6330
Was $399 **THIS MONTH: $299**

Upgrade kits to suit — Half Price:
40 metre K-6332 20 metre K-6333 15 metre K-6334 10 metre K-6335
Were $39.95 each . . .
THIS MONTH: $19.95 ea.

100W+ Of HF Muscle
10 to 14dB gain on all HF bands — expect around 150W PEP or so from a 5W input on all bar 28 (3dB lower). Cat K-6331
Was $379 **THIS MONTH: $299**

100 W On SIX, Too.
All-mode amp needs only 6W drive for 100W out. Includes carrier operated relay. Cat K-6349
Was $329 **THIS MONTH: $279**

And A New DIY SW Receiver:
Features 3 bands from 0.48 to 17.12MHz, a great "start-up" kit (great for school projects). Now available in limited quantities in all DSE stores. Cat K-6355

ONLY $79.95

HURRY — SOME STOCKS LIMITED!

LIMITED QUANTITIES OF THESE KITS AVAILABLE AT ALL DICK SMITH ELECTRONICS STORES . . . OR PHONE YOUR ORDER DIRECT TO TOLL FREE (008) 22 6610 (SYDNEY AREA 888 2105)

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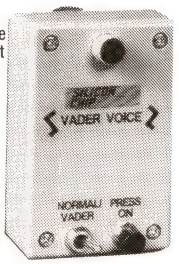
DICK SMITH ELECTRONICS

NEW KITS THIS MONTH!

...AND A FEW FROM LAST MONTH

Vader Voice



Shades of Star Wars! The kids'll have a ball with this one: just speak into it and your voice comes out just like Darth Vader's! Nifty little kit, complete in one zippy box.
Cat K-3510

Perfect Beginner's Project!

As seen in 'Silicon Chip'

$29.95

Hands-Free Phone

You could spend hundreds of dollars on a hands-free phone. Or you could build this kit. Simple, effective – and cheap! Use in conjunction with existing phone for full two-way hands-free conversation. Cat K-3100

As seen in 'Silicon Chip' **$89.95**

Studfinder

If you've ever hammered a nail into a wall – and missed the stud – this one's for you! Easy to build (one night project) is perfect for the home toolbox. (Sorry, it cannot detect the other type of stud!) Cat K-2723

As seen in 'Electronics Australia' **$19.95**

Guitar Practice Amplifier

Short form kit.(PCB & components only – you decide which case you want to put it in) giving a neat little 8 watt amplifier for guitar and similar practice.
Cat K-3548

As seen in ' Australian Electronics Monthly' **$19.95**

Lab Power Supply

35 volt, 2A supply for the workbench, lab, technician or hobbyist. Fully metered, extremely easy to build and very versatile. Cat K-3461

As seen in ' Australian Electronics Monthly' **$109**

EA's new 30/30 Amplifier

Remember the twin 25 of a decade ago? We made countless thousands of kits! Here's the up-to-date model: EA's new 30-30 Amplifier. Easy to build, an ideal project for schools, tech colleges, etc – or just the hobbyist who wants a hi-spec kit at a low-spec price.

- 30W per channel
- 0.025% distortion at 30W
- -76dB (phono) and -91dB (line) noise figure

Special 'Short Form' Kit:

We've made up a special kit for this amplifier which includes all the "expensive" and hard-to-get bits – the power amplifier IC's, the transformer, the silk-screened & punched front panel and the printed circuit board.

The other components (such as the passive components, pots, etc) are normal stock lines at your nearest Dick Smith Electronics store (or you may even have many of them in your junk box!). Cat K-5100

As seen in 'Electronics Australia'

Short form kit as described above: $99.95

Our Kit Policy . . .

Where we advertise a kit from an electronics magazine, it is our firm policy to have that kit in our stores no later than the fifteenth day of the month of issue of the appropriate magazine (usually we do much better than that!)

It's part of our committment to the hobbyists and enthusiasts of Australia and New Zealand. We want you to have the latest kits, at the best possible prices, and as soon as possible.

Occasionally, we're let down: an oddball component that has to come from the other side of the world; a shipping or dock strike that delays vital parts; perhaps a magazine that changes its mind about the month of publication (or even about the design of the project!).

If we let you down by not having the kit you want in the store when we've promised it, we apologise. We hope you'll understand that we're doing our very best to fix the problem – but they're not always that 'fixable'. Don't forget that there are 'rain checks' available in all stores to ensure that you don't miss out when the stock arrives – you'll get it for the price advertised and written on the rain check.

Dick Smith Electronics.

At Last! Recently Released Kits

At time of going to press, there were good stocks of these in our stores. But don't blink . . .

Discolight

Move over, Musicolor: Discolite is here. It's the latest in colour organs, with chaser, audio chaser, etc etc. You want a light show? Discolite is what you want! Cat K-3150

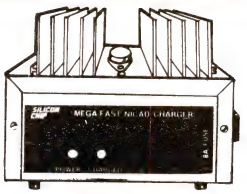
As seen in 'Silicon Chip' **$165**

Strobotuner

Accurately and professionally tune virtually any musical instrument with this fully self-contained and portable kit. If you're into music, get into this! Cat K-3550

$54.95

As seen in 'Electronics Australia'



Nicad Charger

Megafast! What you read is what you get – charge 7.2V r/c model type Nicads quickly, but safely: about 15 to 20 minutes, without risk of overcharge. Cat K-3477

As seen in 'Silicon Chip' **$45**

Speaker Protector

Your speakers are in deadly peril every time you turn your amplifier on (or if it goes into amplificus cactus). Protect your valuable speakers with this easy-to-build and easy-to-fit kit. Cat K-4008

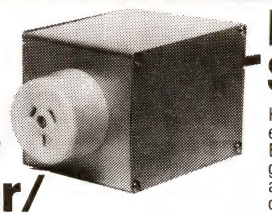
$37.95

As seen in 'Electronics Australia'

Chair/Tilt Alarm

Nifty little alarm circuit designed to go off on movement (more precisely, change of angle). It's a great way to protect perambulatory property participating in purloining, pillaging, pilfering, pinching or plundering. Cat K-3248

As seen in ' Australian Electronics Monthly' **$11.95**



Line Filter/ Conditioner

Commercial line filters cost a fortune: build your own for a lot less. Filters out HF noise, spikes, etc and gives over-voltage protection.
Cat K-3080

As seen in 'Electronics Australia' **$39.95**

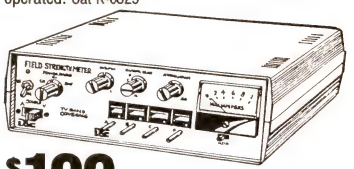
Budget Power Supply

A low-cost variable supply that's ideal for beginners (no need to mess around with mains – it can be powered from a battery if you wish – or any other AC or DC source). No metering, no frills, but economical! Cat K-3460

As seen in ' Australian Electronics Monthly' **$62.50**

Relative field Strength Meter

Here's one for the antenna installers, TV techs, etc. Checked out the price of a FSM lately? Build this instead for an xteenth the cost! Gives good relative indication, works on VHF & UHF, and even gives out video signal. Battery/mains operated. Cat K-6329

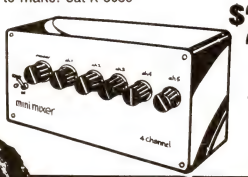


$199 **As seen in 'Electronics Australia'**

Mini Mixer

Here's a great beginners project – with specs that make it good enough for serious use. 4 input mixer suits mics, guitar, etc – very simple to make. Cat K-3039

$29.95



As seen in ' Australian Electronics Monthly'

DICK SMITH ELECTRONICS

TV BROADCASTING SYSTEMS, WORLDWIDE

COUNTRY	T.V. BROADCASTING SYSTEM			FREQ.	POWER VOLTAGE
	VHF	UHF	COLOR		
Afghanistan	B		PAL	50	220
Alaska	M		NTSC	60	120/240
Albania	B	G			
Algeria	B		PAL	50	127/220
Angola	I	I		50	220
Argentina	N	N	PAL	50	220
Aruba	M			50/60	115/127
Australia	B	G	PAL	50	240
Austria	B	G	PAL	50	220
Azores	B		PAL	50	110/220
Bahamas	M		NTSC	60	120/240
Bahrain	B		PAL	50/60	110/230
Bangra-Desh	B		PAL	50	230
Barbados	M		NTSC	50	115
Belgium	B	H	PAL	50	127/220
Benin	K1			50	220
Bermuda	M		NTSC	60	120
Bolivia	M/N	M	NTSC	50	110/115/220/230
Bonaire	M			50	127
Botswana	I	I		50	220
Brazil	M	M	PAL	60	127/220
Bulgaria	D	K	SECAM	50	220
Burma	M		NTSC	50	230
Burundi	K1	K1		50	220
Cambodia	M			50	120/220
Cameroon				50	220
Canada	M	M	NTSC	60	120
Canary Islands	B	G	PAL	50	127/220
Centr. African Rep.	B	K1		50	220
Ceuta	B	G	PAL	50	220
Chad	K1	K1		50	220
Chile	M		NTSC	50	220
China (People Rep.)	D		PAL	50	220
Colombia	M	M	NTSC	60	110
Congo (Rep. of)	D		SECAM	50	220
Costa Rica	M	M	NTSC	60	120
Cuba	M	M	NTSC	60	110
Curacao	M	M	NTSC	50	127
Cyprus	B	G	PAL	50	240
Czechoslovakia	D	K	SECAM	50	220
Denmark	B	G	PAL	50	220
Djibouti	K1		SECAM	50	220
Dominican Rep.	M	M	NTSC	60	110
Egypt	B	G	SECAM	50	220
El Salvador	M	M	NTSC	60	115
Equador	M	M	NTSC	60	110/120/127
Ethiopia	B	G		50	220
Fiji	B		PAL	50	240
Finland	B	G	PAL	50	220
France	E	L	SECAM	50	115/127/220
Gabon	K1	K1	SECAM	50	220
Gambia	I	I		50	230
Germany (Dem Rep. of)	B	G	SECAM	50	127/220
Germany (Fed Rep. of)	B	G	PAL	50	220
Ghana	B	G	PAL	50	250
Gibraltar	B	H	PAL	50	240
Greece	B	H	SECAM	50	220

COUNTRY	T.V. BROADCASTING SYSTEM			FREQ.	POWER VOLTAGE
	VHF	UHF	COLOR		
Greenland	M		NTSC	50	220
Guadeloupe	K1	K1	SECAM	50	220
Guam	M	M	NTSC	60	120
Guatemala	M	M	NTSC	60	120
Guiana (French)	K1	K1	SECAM	50	220
Guinea	K1	K1		50	220
Haiti	M		NTSC	60	115/220
Hawaii	M		NTSC	60	117
Honduras	M		NTSC	60	110
Hong Kong		I	PAL	50	200/220
Hungary	D	K	SECAM	50	220
Iceland	B	G	PAL	50	220
India	B		PAL	50	230/250
Indonesia	B		PAL	50	127/220
Iran	B	G	SECAM	50	220
Iraq	B		SECAM	50	220
Ireland	A/I	I	PAL	50	220
Israel	B	G	PAL	50	230
Italy	B	G	PAL	50	127/220
Ivory Coast	K1	K1	SECAM	50	220
Jamaica	M	M	NTSC	50	110
Japan	M	M	NTSC	50/60	100
Jordan	B	G	PAL	50	220
Kenya	B	G	PAL	50	240
Korea (Dem Rep. of)	D		PAL	60	220
Korea (Rep. of)	M		NTSC	60	100/220
Kuwait	B	G	PAL	50	240
Lebanon	B		SECAM	50	110/220
Leeward Islands (Antigua)	M		NTSC	60	230
Liberia	B	H	PAL	60	120
Libya	B	G	SECAM	50	127/230
Luxemburg	C	L/G	SECAM/ PAL	50	120/220
Madagascar	K1		SECAM	50	127/220
Madeira	B		PAL	50	220
Majorca Islands	B	G		50	127/220
Malaysia	B	G	PAL	50	240
Malawi	B	G		50	230
Mali (Rep.)	K1	K1		50	220
Martinique	K1		SECAM	50	220
Mauritius	B	I	SECAM	50	230
Mauritania	K1	K1		50	220
Mexico	M	M	NTSC	60	125
Monaco	E	L/G	SECAM/ PAL	50	127/220
Mongolia	D		SECAM	50	220
Morocco	B	H	SECAM	50	115/127/220
Netherlands	B	G	PAL	50	220
New Caledonia	K1	K1	SECAM	50	220
New Zealand	B		PAL	50	230
Nicaragua	M	M	NTSC	60	120
Niger	K1	K1	SECAM	50	220
Nigeria	B	G	PAL	50	230
Norway	B	G	PAL	50	220/230
Oman	B	G	PAL	50	220
Pakistan	B		PAL	50	220/230

COUNTRY	T.V. BROADCASTING SYSTEM			FREQ.	POWER VOLTAGE
	VHF	UHF	COLOR		
Panama	M		NTSC	60	110/115/120
Paraguay	N	N	PAL	50	220
Peru	M	M	NTSC	60	220
Philippines	M	M	NTSC	60	110/115/220
Poland	D	K	SECAM	50	220
Portugal	B	G	PAL	50	220
Puerto Rico	M	M	NTSC	60	120
Qatar	B		PAL	50	240
Reunion	K1	K1	SECAM		
Romania	D	K	SECAM	50	220
Rwanda	K1	K1		50	220
Samoa (American)	M		NTSC	50	230
Sandi Arabia	B	G	SECAM	50/60	127/220
Senegal	K1	K1	SECAM	50	127
Sierra Leone	B	G	PAL	50	230
Singapore	B	G	PAL	50	230
Somalia (Rep. of)	B	G		50	110/220/230
South Africa	I	I	PAL	50	220/230/250
Spain	B	G	PAL	50	127/220
Sp. West Africa	B	G			
Sri Lanka	B		PAL	50	230
St. Martin	M		NTSC	60	120
St. Pierre et Miquelon	K1		SECAM		
Sudan	B		PAL	50	240
Surinam	M		NTSC	60	110/115/127
Sweden	B	G	PAL	50	220
Switzerland	B	G	PAL	50	220
Syria	B	H	SECAM	50	115/220
Tahiti	K1	K1	SECAM	50	127
Taiwan	M		NTSC	60	110
Tanzania	I		PAL	50	230
Thailand	B		PAL	50	220
Togo Rep.	K1		SECAM	50	220
Trinidad	M	M	NTSC	60	115/230
Tunisia	B		SECAM	50	220
Turkey	B	G	PAL	50	220
Uganda	B	G	PAL	50	240
United Arab Emirates	B	G	PAL	50	220/230/240
United Kingdom	A	I	PAL	50	240
Upper Volta (Rep.)	K1	K1		50	220
Uruguay	N	N	PAL	50	220
U.S.A.	M	M	NTSC	60	117
U.S.S.R.	D	K	SECAM	50	127/220
Venezuela	M		NTSC	60	120
Vietnam	D/M			50	120/220/230
Virgin Islands	M		NTSC	60	120
Yemen	B		PAL	50	220
Yemen (Dem Rep. of)	B		PAL	50	230
Yugoslavia	B	H	PAL	50	220
Zaire	K1		SECAM	50	220
Zambia	B	G	PAL	50	230
Zanzibar	I	I	PAL		230
Zimbabwe	B	G		50	230

Super VHS — will it spark a new video revolution?

Malcolm Goldfinch

Super VHS video will "arrive" in Australia this month. It promises much improved clarity and definition, exceeding broadcast standard video, in fact. How does it work and what will be its impact?

THE ACE up the sleeve of VHS, which won the video format war hands down, was *ncompatibility* throughout the years of development. A tape made on a machine ten years ago can be played on today's latest machine, and today's latest movie releases on video can be played on a 10 year-old machine.

Now the format battle is won, JVC and their cohorts of the VHS format can afford a small deviation from full compatibility with their latest development, Super VHS. It's but a small price to pay for the advantages Super VHS offers.

The Australian consumer gains a giant leap forward into professional video quality and the ability to record and replay tapes almost world-wide, virtually wherever there's a 625-line TV standard employed. All this at a price which many can afford right now, and in the usual way with consumer electronics, many more will be able to afford in due course.

The only loss in compatibility is that a Super VHS-recorded cassette will not play in a VHS VCR, but the Super VHS VCR will play VHS cassettes and will make a standard VHS recording which can be played in any VHS VCR. The Super VHS VCR will replay either Super or standard VHS and selects the correct mode automatically.

While its initial impact will be relatively low key, in time Super VHS will bring something of a revolution to both domestic and professional video, according to the pundits.

Background

The inventors of VHS, JVC, launched Super VHS at the Chicago Consumer Electronics Show last year (see *The "Claytons" Consumer Electronics Show*, AEM September 1987, p. 30), demonstrating a system in the 525-line NTSC TV format, as used for TV in the US and Japan.

JVC also demonstrated the NTSC-version Super VHS system at the 1987 Perth Electronics Show in late July, for the first showing of Super VHS in Australia. Panasonic followed in March this year, demonstrating an NTSC-version SVHS system at their dealers conference in Sydney.

In January this year, JVC announced the specifications for the European version of Super VHS, for TV systems employing 625-line scanning, which covers the PAL and SECAM standards.

In June, JVC launched their "Euro System" SVHS products here at a press function at the Sydney Opera House, coinciding with the Society of Motion Picture and Television Engineers' (SMPTE) exhibition. Three weeks later, Panasonic hosted a press breakfast afloat on Sydney harbour to launch their range of Euro system SVHS products.

JVC had an SVHS VCR, the HR-S5000, and two "prototype" SVHS cameras — one for full-size cassettes, one for C-format cassettes. While the VCR was demonstrated, the cameras were not. Panasonic demonstrated a VCR (NV-FS1), a camcorder (NV-MS1) and several new large-screen TV receivers with "S-terminal" inputs.

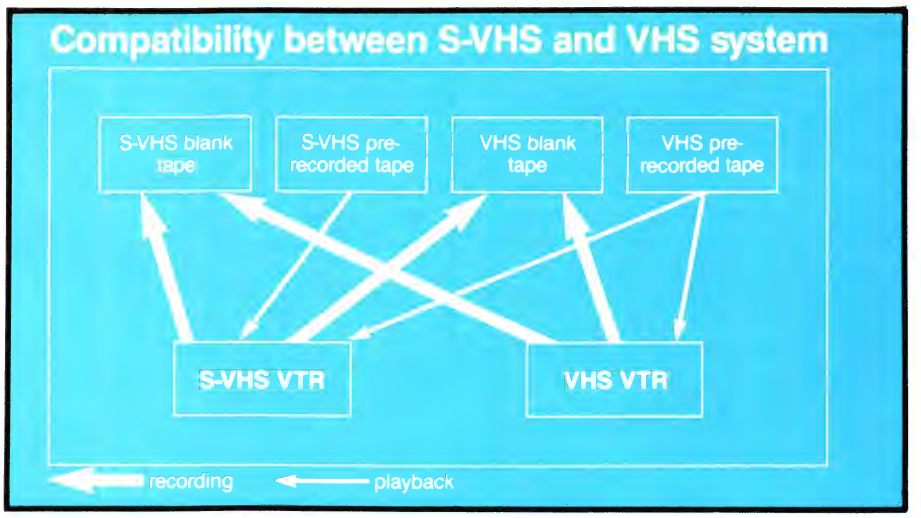
The thing about the Euro System is that it is a unified standard for countries with a 625-line TV system. For consumers and the software makers, that's a big plus. Here's why.

The divided video world

The accompanying tables show the variety of TV systems used around the world. Three, however, dominate. They are: NTSC (525 lines/60 Hz), SECAM (625 lines/50 Hz) and PAL (625 lines/50 Hz). Geographically, Japan, parts of S.E. Asia, North America and parts of South America use the NTSC system. Throughout most of the rest of the world, PAL or SECAM are employed.

The Super VHS Euro System exploits the basic "compatibilities" the PAL and SECAM TV systems offer - 625 lines/screen, 50 Hz field frequency, 25 pictures per second and 15 625 Hz line frequency.

It's surprising just how few people are ▷



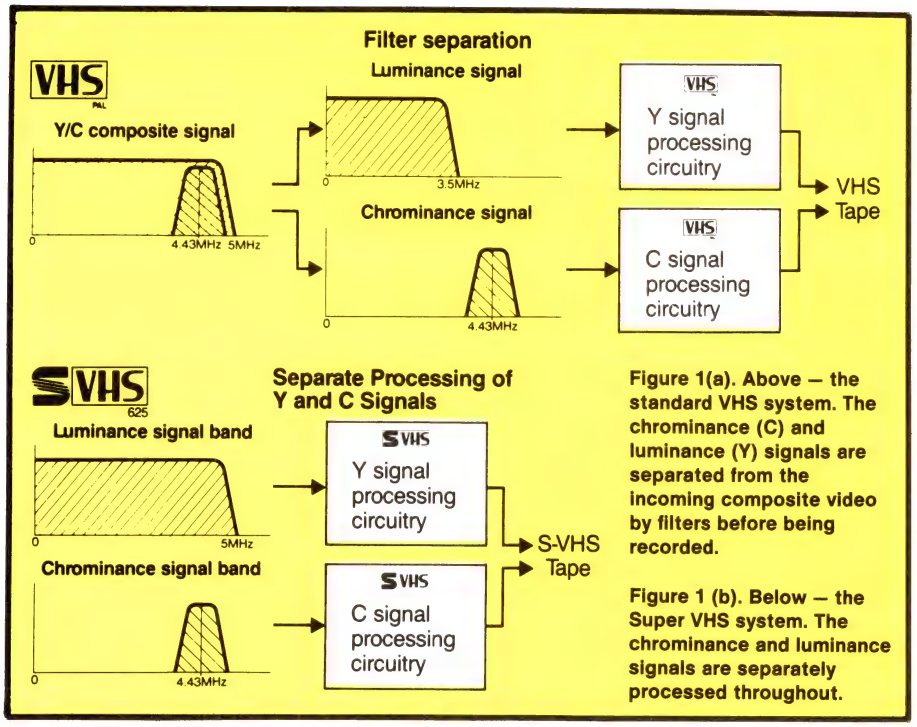


Figure 1(a). Above — the standard VHS system. The chrominance (C) and luminance (Y) signals are separated from the incoming composite video by filters before being recorded.

Figure 1 (b). Below — the Super VHS system. The chrominance and luminance signals are separately processed throughout.

aware that there are different TV systems. To most TV viewers, TV is TV. Mention NTSC or even PAL, and they look at you with glazed eyes; SECAM sounds like a French oath!

Only those who travel with a camcorder and try to play back on a local TV suddenly become aware that there is more than one type of television standard in the world. This group of surprised and frustrated video users is growing rapidly. You'll rarely find a warning, even in the fine print.

This problem is similar to the old conundrum with early electric shavers, beloved of travellers; going from countries with 110 V/60 Hz mains to 220-240 V/50 Hz in others — or worse, dc mains — the shavers either did not work or blew up.

And how about sending video tapes to friends, relatives or business associates overseas?

It has been said that the world's largest number of compatible TV users are in the Americas and Japan. In terms of sheer numbers for a single TV system (NTSC), that's a pretty true statement. But if the PAL and SECAM TV "populations" are taken together, then *they* dominate the video world, Europe having the greatest market. Hence, the Super VHS Euro System.

While the video systems are compatible at the base level, and tapes made in Australia can be played in the UK, France, Germany et al, there are remaining incompatibilities between the broadcast TV systems themselves. Chiefly, this involves the sound carrier in the TV signal. With the Australian PAL TV system, the sound carrier is displaced 5.5 MHz above the vision carrier. In the UK TV system, for example, it's at 6 MHz, in other areas it's at 6.5 MHz.

Because VCRs incorporate an RF output so that they may be connected to the antenna of a television set that does not have an audio/video (AV) input connector, the RF modulator must be specific to the TV broadcast system in the country in which the VCR is to be sold. A VCR intended for the UK market cannot be used in Australia, for example. The same goes for the RF output of camcorders. In addition, there is the "parsley" which garnishes certain PAL areas with added services in the flyback pause, to be considered: videotext.

Thus, VCRs sold in different areas of Europe have different detection and decoding facilities. Hence, you'll find these products marked with a special suffix to indicate the intended market country: E is the general "European market" suffix and this is compounded to EG for West Germany, EH for the Scandinavian countries, EK for the United Kingdom, etc.

The technique

In the standard VHS recording system, the composite video signal is separated

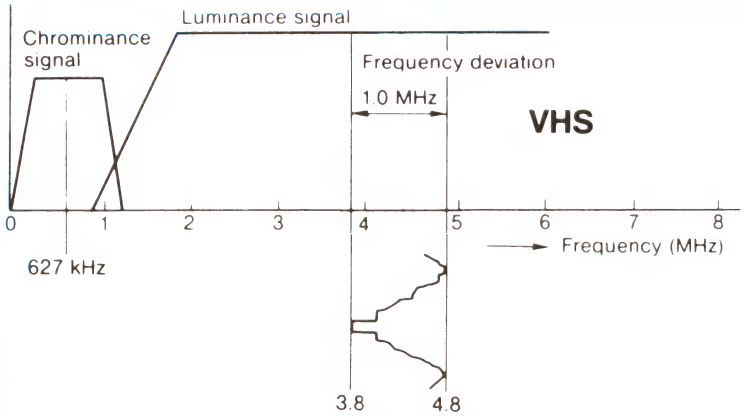
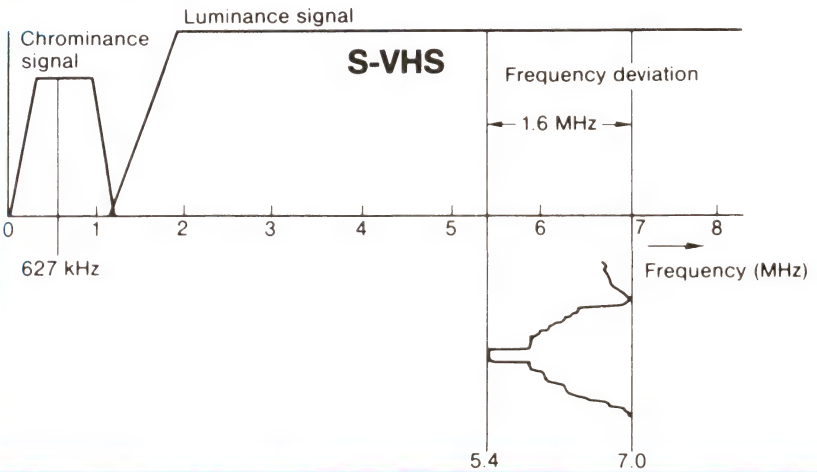


Figure 2(a). Above — spectrum of the video head signal of a standard VHS recording. The chrominance signal carrier is down-converted to 627 kHz, the luminance signal modulated on a 4.3 MHz carrier with 1 MHz deviation. The sidebands of the luminance signal extend down to the 1 MHz region, overlapping the chrominance sidebands in the same region.

Figure 2(b). Below — spectrum of the video head signal of a Super VHS recording. The chrominance subcarrier is still on 627 kHz, but the luminance is modulated on a 6.2 MHz carrier with 1.6 Mhz deviation. The sideband overlap between the signals in the 1 MHz region is reduced, cutting interference between the two signals.



into its two components - chrominance (colour), or the C signal, and luminance (intensity, the range between black and white), or Y signal — using filters to separate them, as illustrated in Figure 1(a). The Y signal also carries the synchronising (sync) pulses.

The luminance signal bandwidth, which determines the ultimate resolution of the picture, is "rolled-off" at about 3.5 MHz for reasons which will be explained shortly. The chrominance signal frequency modulates a 4.43 MHz subcarrier. In the VCR, this is down-converted to a 627 kHz carrier, while the luminance signal frequency modulates a 4.3 MHz carrier, with a deviation of 1 MHz from peak white to the sync pulse tip. See Figure 2(a). The 4.3 MHz subcarrier also serves as the high frequency bias signal for the tape.

The overlap of the chrominance and luminance signals in the 1 MHz region must be restricted to reduce interference that affects picture quality that shows up as "cross colour" noise and "dot interference" (which smears sharp vertical edges and produces Moire patterns in some scenes). The bandwidth of the incoming luminance signal is restricted to restrict the sidebands of the 4.3 MHz luminance carrier on tape.

Broadcast video has a luminance bandwidth of 5.5 MHz, while standard VHS is limited to 3.5 MHz. It is this that limits the horizontal resolution of standard VHS to about 240 lines, while broadcast video has a resolution of 330 lines.

In the Super VHS system, the luminance and chrominance signals are always separated throughout record and playback (Figure 1(b)). The full luminance signal bandwidth is maintained throughout.

As in standard VHS, the chrominance signal subcarrier is down-shifted to 627 kHz, but now the luminance subcarrier is on 6.2 MHz and the deviation is expanded to 1.6 MHz; peak white is now at 7.0 MHz and the sync tip at 5.4 MHz. (Figure 2(b)). This allows the luminance subcarrier sidebands more "room" before they overlap the chrominance subcarrier sidebands around 1 MHz, while the greater deviation improves the video signal-to-noise ratio.

Currently, VCRs provide both an RF output and composite video. The latter is for direct connection to either a monitor or a TV with such an input fitted, as many late model sets have. Super VHS VCRs also provide these outputs, to maintain compatibility with existing equipment consumers may have. But to take full advantage of the quality that the signal processing system provides, they have an additional connector, dubbed the "S-terminal". This simply provides separate inputs/outputs for the chrominance and luminance signals.

However, that implies the VCRs are to be used with monitors/receivers that are similarly fitted. Too right! The best result is obtained by maintaining the separation of the chrominance and luminance signals from video head to picture tube. Figure 3 shows the general block diagram of an SVHS video recorder.

In order to reduce the noise that is the usual accompaniment to wider bandwidth signals, special circuitry in the SVHS VCR provides for some noise reduction, akin to the noise reduction provided by pre-emphasis and de-emphasis

• to page 118. ▷

Super VHS Euro System Specifications (625 lines/50 Hz)

1. Cassette Tape conforming to S-VHS Euro System standard
   High performance tapes
   SE-180, SE-120, etc. : Full-size VHS cassette with an ID (identification) hole
   SE-C30 : Compact VHS cassette with an ID hole

2. Recording Modes
   SP mode : tape speed : 2.34 cm/sec
   recording time : 3 hours (with an SE-180 cassette)
   LP mode : tape speed : 1.17 cm/sec
   recording time : 6 hours (with an SE-180 cassette)

3. Video Signal Recording System
   Video input/output signal : PAL signal, SECAM signal, or some other signals (such as MAC signals)
   Luminance signal recording : Frequency modulated (FM) recording
   FM carrier frequency
   White peak : 7.0 MHz
   Sync tip : 5.4 MHz
   Deviation : 1.6 MHz
   Clip level
   White clip level : 210 %
   Dark clip level : 70 %
   Emphasis
   Main emphasis : VHS standard emphasis
   Sub emphasis : Non-linear emphasis
   Chrominance signal recording : Colour-under phase-shift recording of quadrature modulated chrominance signal
   Carrier frequency : 627 kHz

4. Audio Signal Recording System
   Linear track recording : Conforming to VHS audio recording method
   FM recording : Conforming to VHS audio recording method

5. Playback (signal) Performance
   Horizontal resolution : More than 400 lines

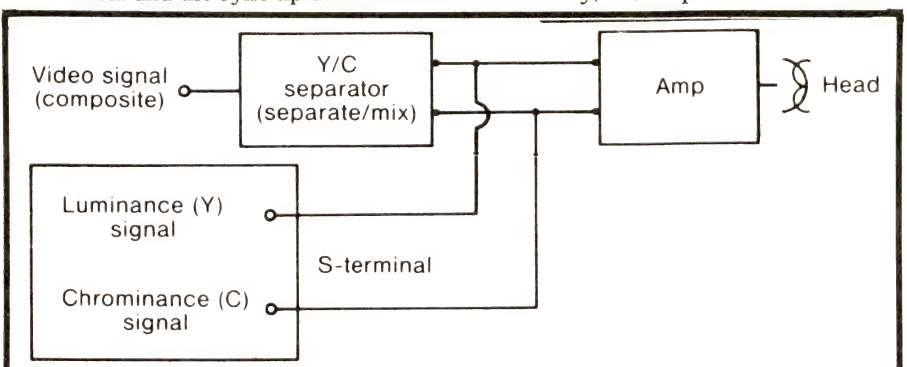
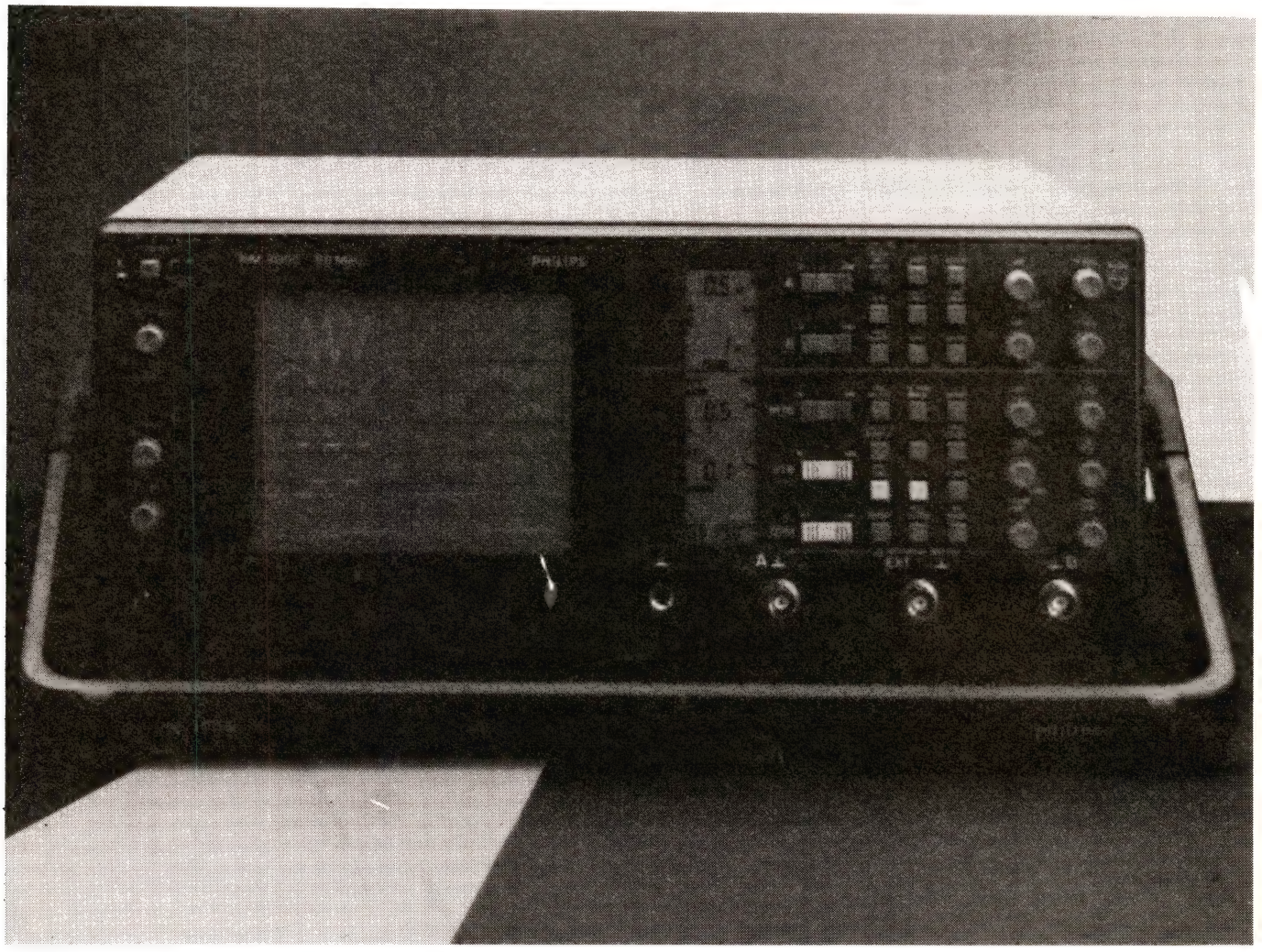


Figure 3. Block diagram of a Super VHS VCR. In record mode, input may be composite or from the S-terminal, with the Y and C signals separated. The composite signal is separated into the Y and C components first. The Y and C signals are then modulated onto the carriers, amplified and applied to the video heads.

On playback, output from the video heads is amplified and the two carriers demodulated, the separated components going to the S-terminal or to the composite video terminal via a mixer.



Here's a prize every reader will want!

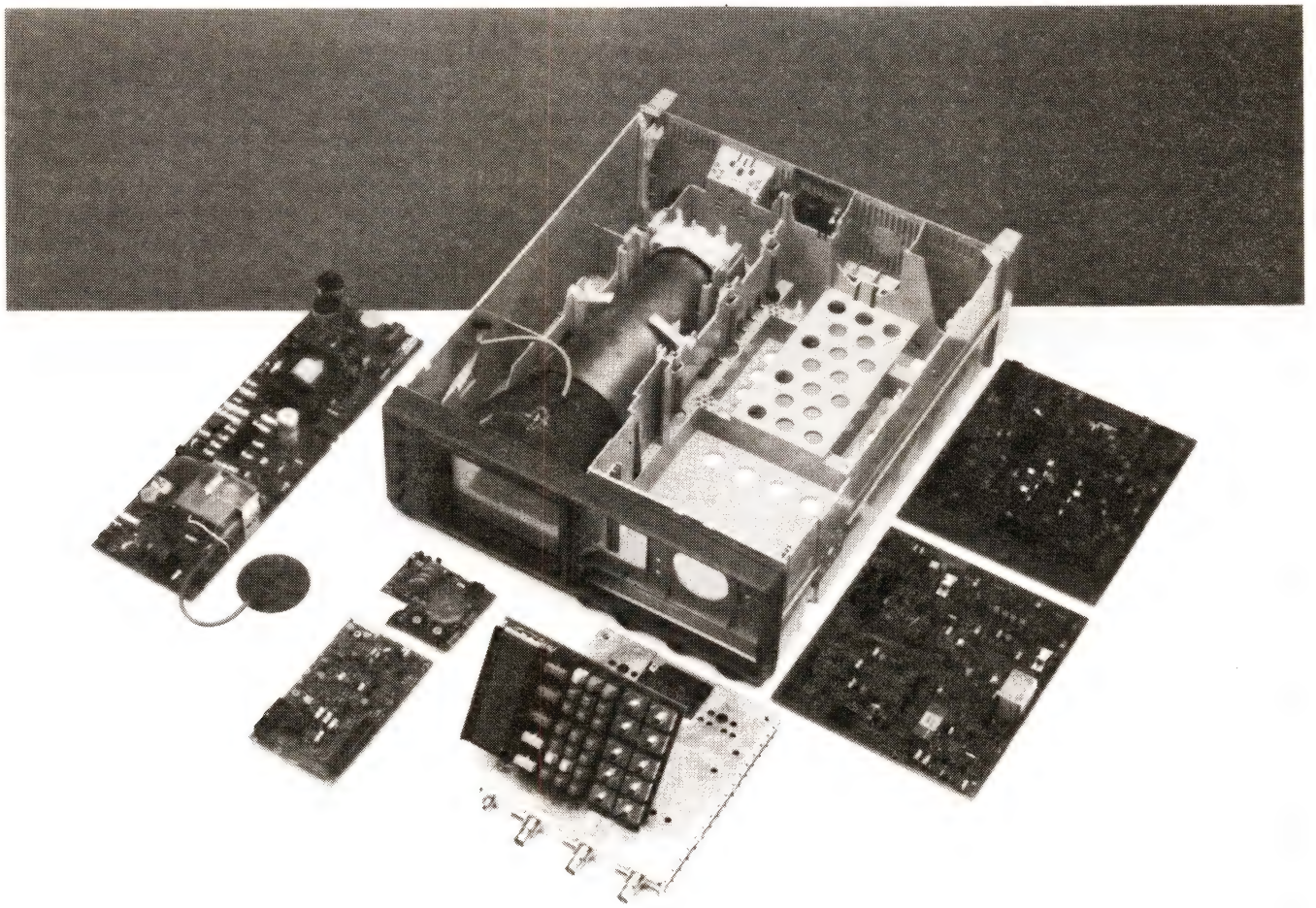
Win this Philips microprocessor-controlled CRO, model PM3055 – it started life as a 50 MHz CRO, but now features a bandwidth of 60 MHz! PLUS – it comes with two x10 100 MHz bandwidth probes!

Here is a fantastic opportunity to own one of the most sophisticated dual-trace CROs available in its class. Engineer or enthusiast – this is a truly great instrument that will give satisfaction for many years. We thought the PM3055 was such a great instrument after we'd reviewed it last year, we got one for use here at the magazine!

You might remember we gave away a PM3055 as a prize in our 1st Birthday Contest series in 1986! Missed your chance then? Well, have another go!

The PM3055 does away with the conventional rotary switches used on most CROs to select ranges and functions. Instead, selection is by up/down rocker controls and multi-function "softkeys", greatly reducing the number of front-panel controls required. And you "read" the front panel like a book – left to right, top to bottom. It's a natural! Indication of the ranges selected, and the status of the various controls is made on a large LCD panel next to the CRT.

The microprocessor-controlled "Autoset" function is



This prize is worth around $2700!

a considerable time-saver in a wide range of applications. This automatically optimises settings for trace amplitude, plus timebase speed and triggering, to bring any connected signal in range and provide a usable display without the need to laboriously adjust manual settings.

The 8 x 10 cm CRT features a parallex-free graticule with variable illumination. Vertical sensitivity is adjustable over the range 2 mV – 10 V per division. Timebase speeds range from an impressive 50 ns right down to 0.5 seconds. The PM8936/09 10:1 probe set is supplied with this superb instrument. Input sensitivity of the probes is selected automatically and shown on the LCD display when they are plugged in. And the probes feature a bandwidth of 100 MHz!

The injection moulded chassis makes this CRO a very sturdy instrument, and service and repair is greatly facilitated by the modular component assemblies.

CONTESTS CLOSE 31 OCT. 1988

Prize kindly donated by Philips Scientific & Industrial, PO Box 119, North Ryde 2113 NSW.

1) Prior to the 1930s, cathode ray tubes contained a small proportion of a rare gas. Which gas?

. . . . . .

2) Philips Scientific & Industrial recently moved, what was their *old* address?

. . . . . .

3) When using the Philips PM3055 oscilloscope, hitting the 'Autoset' button will optimise the setting for trace amplitude, timebase speed and triggering. What colour is this magic button?

. . . . . .

In 25 words, or less – why do want this prize?

I have read the rules of the contest and agree to abide by their conditions.

Signature: _____

Name: _____

Address: _____

_____ P/Code: _____

Phone: (____) _____

NOTICEBOARD

This special page is for the benefit of readers, to help you make better use of your magazine.

Please check this page **every month** as notices **will** be changed often.

Special Offers

We pride ourselves in making available to you special opportunities to purchase interesting products at a special price.

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ERRATA

THE SPINE, July 1988: Amend it NOW, to read Vol.4, No.1.

AEM2520BUDGET BENCH SUPPLY, July '88: There are two small errors on the wiring diagram, page 62, and an omission on the overlay. The cathode of LED1 goes to point B, not H, while the anode of LED2 goes to point G, not N. The positive leg of C2, a tantalum, is on the left hand side.

WHERE DO YOU GET IT?

Where do you buy the parts and PCBs for the projects? Every issue has a column called "Retail Roundup", in which you will find the "Project Buyers Guide", usually in a box on the page. This provides a guide to where you might buy your needs for the projects featured in that particular issue.

PROJECT LEVELS

In general, with our projects we include a panel indicating the "level" required for successful construction. This is included only as a guide, the three levels we show being: "beginners",."intermediate" or

LEVEL: We rate this construction project as suitable for:

EXPERIENCED

constructors who have successfully assembled a variety of projects of differing complexities.

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MAGAZINES WITHDRAWN FROM SALE

Commencing with the July issue, and until further notice, copies of AEM will no longer be available through Jaycar stores, having been withdrawn by the publisher. We apologise to readers who may be inconvenienced by this.

The magazine will still be normally available through newsagents, of course, and other electronics stores; Dick Smith Electronics in all states and New Zealand; in Adelaide, Eagle Electronics and Force Electronics; in Melbourne, All Electronic Components, Preston Electronics, Ritronics and Stewart Electronic Components; in Sydney, David Reid Electronics and Hi-Com Unitronics. The magazine is still distributed through newsagents, too.

Back Issues

If you are looking for a particular back issue, it's simple, just write to us: **AEM, 1st Floor, 347 Darling Street, Balmain 2041 NSW** and state which issue(s) you need, enclosing a cheque or money order for $4 for each back issue.

It is wise to state which particular article or project interests you in the issue(s) you have specified, because if we don't have the issue in stock, we can send you a photostat of your specified article or project. We are unable to process back issues by credit card, unfortunately, unless the order is above $10.

GOT OUR RIGHT ADDRESS?

Most important! It has become obvious to us that a lot of readers are still addressing mail to our old addresses (there are three variations) so will you make sure that you have our new address, phone and fax numbers?

AEM
1st Floor, 347 Darling Street,
BALMAIN 2041 NSW.
Ph. (02)555 1677. Fax: (02)555 1440

Technical Enquiries

Please, only after 4.30 pm EAST.

If you were a fly on the wall in our office you would notice that the people who answer these enquiries do not sit all day with baited breath awaiting your call. In actual fact they are crucial members of our team and are expected to do 'some' other work during 'normal' business hours. So please, while we are happy to answer your technical enquiries we also have a magazine to get out. After all, isn't that how you found us in the first place?

SIEMENS

Surge Arresters

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There's an explosion of new demands for surge voltage protection.

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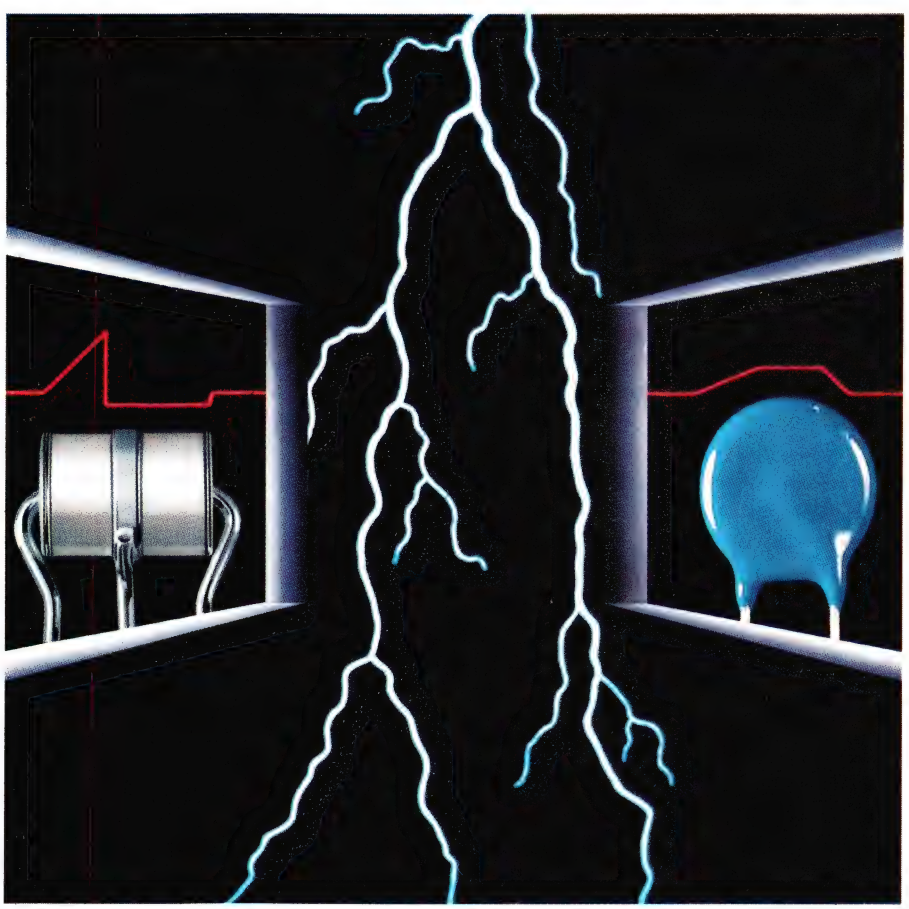
For more information, contact your nearest Siemens office or distributor.



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3RD BIRTHDAY CONTEST No.2.

Slave over a hot soldering iron, not a hot stove!

Win this NEC Microwave Oven!

You would, of course, prefer to spend more time on interesting pursuits than at functional activities such as making meals. Unless making meals is a more interesting pursuit, that is!

Well, Adelaide electronics retailer, Eagle Electronics, has presented you with this dilemma – er, fabulous prize, a top-line microwave oven by NEC. Win this and you'll be able to whip up a quick snack so you can return to that project on the bench, or whatever.

This NEC microwave features all the latest control tricks with it's microprocessor operated control panel. And it's a cinch to operate!

Of course, if you don't want it in the workshop, you could always endear yourself for ever to the rest of the household and donate it to the kitchen!

1) Heart of the microwave oven is the "magnetron", a high power 2.5 GHz oscillator. Name the two men who developed the "cavity magnetron"?

. . . . . .

2) What is NEC's "company slogan"?

. . . . . .

3) Eagle Electronics has an associated company in the kit business. What's its name?

. . . . . .

In 25 words or less, describe the first meal you'd like to cook in this NEC microwave oven.

I have read the rules of the contest and agree to abide by their conditions.

Signature: _____

Name: _____

Address: _____

_____ P/Code: _____

Phone: (____) _____

CONTESTS CLOSE 31 OCT. 1988

STANDBY POWER

We have a large range of sealed lead-acid rechargeable batteries available from stock, ideal for use in uninterruptible power supplies, telecommunications backup, security systems, etc.

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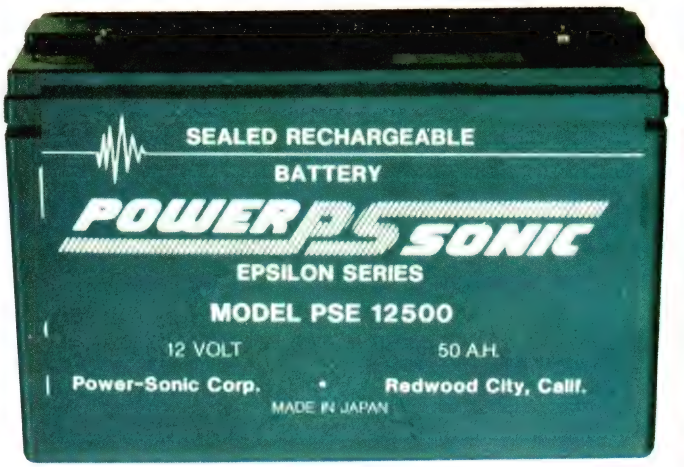

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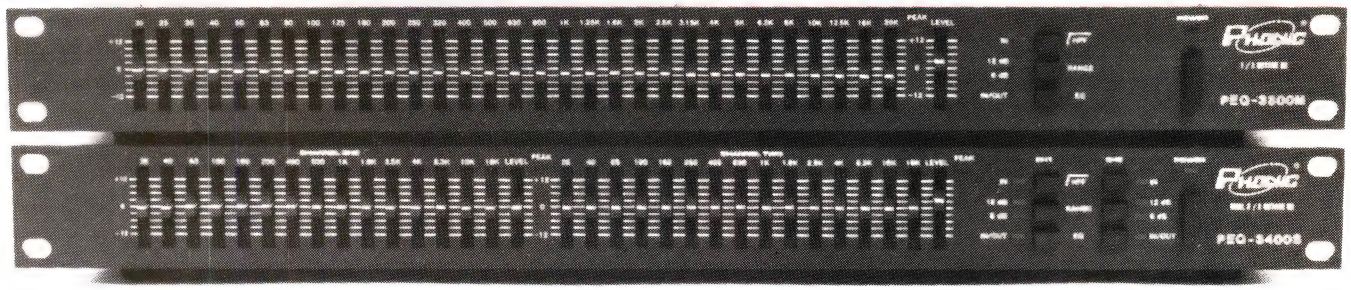


New graphic equalisers were locally designed

Two new professional standard graphic equalisers, designed in Australia and manufactured in Taiwan, have been released by Sydney-based PA specialist, Freedman Sound.

The Phonic PEQ-3300M and the PEQ-3400S incorporate features generally found on more expensive models, according to Freedman, such as low noise, balanced inputs and outputs, 6 or 12 dB selector switch, high pass filter and bypass switch.

These two units two units certainly have impressive specifications, such as: 6 Hz to 85 kHz frequency response; 0.01% total harmonic distortion; 1 V//22k input sensitivity; 1 V/600 Ohms output. Maximum output is given as 8.5 V RMS and noise-for-band gain set at 0 dB is 0.26 mV, at -12 dB is 0.4 mV and at +12 dB is 2.2 mV.

The PEQ-3300M is the mono model with 31 control frequencies between 20 Hz and 20 kHz. The PEQ-3400S is stereo and has 15 control frequencies between 25 Hz and 16 kHz on each channel.

The PEQ-3300M and the PEQ-3400S are both $395, including tax. Further details from **Freedman Sound, 91A Liverpool Rd, Summer Hill 2130 NSW. (02)797 0986.**

Lightning arrestor

A lightning arrester module, dubbed the SAPN, has been added to the range of RFI suppression and electronic protection devices of Schaffner EMC.

The module is designed to protect telecommunications networks and modems from lightning induced power surges.

The insertion loss on a 600

Ohm line is quoted as only 0.14 dB. The arrestor is designed to operate on 200 Vdc lines. It clamps at 280 V for current surges as high as 5000 A.

Any protection device must dissipate large transient power levels. This is achieved by diverting the surge through gas discharge tubes in series with sand filled wirewound resistors. There are no trips to reset after the strike occurs.

High speed clamp diodes are in parallel with the main diverting element to achieve a response time of 15 ns, ideal for digital circuits.

The SAPN is housed in a DIN rail-mountable package. For outdoor applications, weatherproof housings can be supplied containing one, five or twelve units. For further information contact **Westinghouse Systems, PO Box 267, Williamstown 3016 Vic. (03)397 1033.**

Butane heat tools

Master Ultratorch, just released by Bowthorpe Australia, is an ultra-compact, versatile range of heat tools with many applications, including soldering, brazing and localised heating.

It uses inexpensive butane lighter refill fuel flowing through a catalyst to generate high temperatures and requires no electrical lead, gas hosepipe or battery. Bowthorpe say it is ideal for on-site installation and repair work.

The temperature control feature allows solder assembly of circuit boards and TV cable systems, maintenance of switch panels, repairs to TV sets, meters and telephone switchboards.

As a heat tool the Ultratorch provides pin-point accuracy with specially designed heat tip attachments. The non-oxidising heated air flow is perfect for use in a wide range of applications, including shrink tubing and welding plastics.

With a few simple steps all Ultratorch models can be transformed into a high powered torch capable of temperatures suitable for brazing, silver soldering, soft soldering copper tubing and pipes and loosening rusted nuts and bolts.

There are six models and three sizes each of which performs the three functions simply by changing tips. For further information contact your local GEC Electrical Wholesale outlet or Bowthorpe stockist.

Lithium battery holders

Printed circuit mounting low profile dual Lithium coin cell battery holders from Keystone have been introduced by A.P. Imports. They are ideal for computer memory backup, security and alarm backup applications, etc.

The battery holders are available in three sizes to accommodate 20 to 24 mm diameter Lithium cells with heights from 1.6 to 5.0 mm.

They feature notched slots for quick battery insertion and replacements; air-flow design support legs permit safe flow of soldering and enhance air circulation around the battery.

Full details from **A.P. Imports, c/-Post Office, Crossroads 2170 NSW. (02)829 1555.**

Delay line and comp/limiter from JBL

Jands recently announced the release of the 7922 audio delay line, and the 7110 ompressor/limiter, both designed for professional PA use.

The delay line is a one-in/two-out device with a maximum delay time of 327 milliseconds, equivalent to over 100 metres path difference between speaker locations.

The front panel displays A delay time, B delay time, or B referenced to A. Delay settings are non-volatile and ten microsecond steps provide an accuracy of approximately 1/8".

The unit's 16-bit linear conversion and low noise A/D converter offer greater than 90 dB dynamic range with the simplified headroom control providing optimised signal-to-noise performance.

The 7110 has new "SmartScope" compression characteristics plus average blend. An auto-

matic preset button provides a simple set-up engaging a program-dependent variable attack and release circuit, and fixes the compression ratio and peak/average blend controls to critically accepted settings.

Both units are one EIA rack unit packages featuring auto-bypass to ensure signals still flow in the event of power loss. For more information contact **Jands Electronics Pty Ltd, PO Box 171, St Peters 2044 NSW.**

Electronics Show for S.A.

Electronics 88, a conference and exhibition designed to illustrate recent and potential applications of electronic technology covering computing, communications and micro-electronics, will be hosted by The Electronics Association of S.A. next month.

Topic areas for paper presentations and workshops will include: Biomedical engineering, CAD/CAM, automated testing, machine vision, signal processing, micro-electronics as an enabling technology, cellular radio, CD ROMS, HF versus satellite, remote sensing and broadcasting.

A major exhibition which will take up the entire Plenary Hall of the Adelaide Convention Centre will be presented with the conference.

Invitation cards will be made available to exhibitors as well as groups and individuals who have a specific interest in electronics.

The conference will be held from Tuesday 4 October to Thursday 6 October. For further information, contact **The Organisers, Phillip Styles Exhibition Services, 4 Lovell Court, Clarence Gardens, 5039 S.A. (08)371 1700.**

Ultra-mini relays

A new series of ultra-miniature relays from Potter & Brumfield (USA), the T82N series, designed for pc board mounting has been released here by Tecnico.

These DPDT relays feature dual-in-line packaging, permitting their use in a 16-pin DIP socket. The T82N is enclosed in a sealed PBT cover and there is a choice of single or bifurcated contacts rated up to two amps.

Typical applications for the T82N include telecommunication, audio and business equipment. Enquiries to **Tecnico Industries, 11 Waltham st. Artarmon 2064 NSW. (02)439 2200.**

Shrink tubing needs no heat

Airshrink is a highly flexible rubberised PVC based shrink tubing which, when exposed to air, shrinks uniformly to fit any shape.

It is available ex-stock in diameters ranging from 1 mm to 60 mm in red, blue, black and white but can be made to customers' requirements in terms of colour, diameters, wall thickness and lengths of tube.

The product is economical and safe to use as no hazardous heating tools have to be used to shrink the material. No operator skill is needed.

Airshrink comes in a sealed plastic container and the tubing begins to shrink upon contact with the air once it is removed from it's container.

Inside the container is an oily solvent which forms a barrier between the material and the atmosphere. The oily solvent evaporates once it is exposed to the atmosphere, causing shrinkage, some 90% of which occurs within the first hour.

For further details, contact **Airshrink Products, 17 Gladstone St, East Perth 6000 WA. (09)227 9421.**

New siren

A new siren for security alarm applications, model KPE 1100, has been added to the comprehensive range distributed by IRH Components.

The KPE 1100 features a claimed sound output of 110 dB minimum at one metre from a supply of 12 Vdc. It will, however, operate from supplies ranging from 6 V to 12 V, and has a quoted current drain of 450 mA (max.) at 12 Vdc.

It has a frequency sweep between 1500 and 3500 Hz and an operating temperature range of -20° C to +70° C. The KPE 1100 is flange mounted and has flexible lead terminations.

For further information, contact **IRH Components Division of Bell IRH Pty Ltd, 32 Parramatta Rd, Lidcombe 2141 NSW. (02)648 5455.**

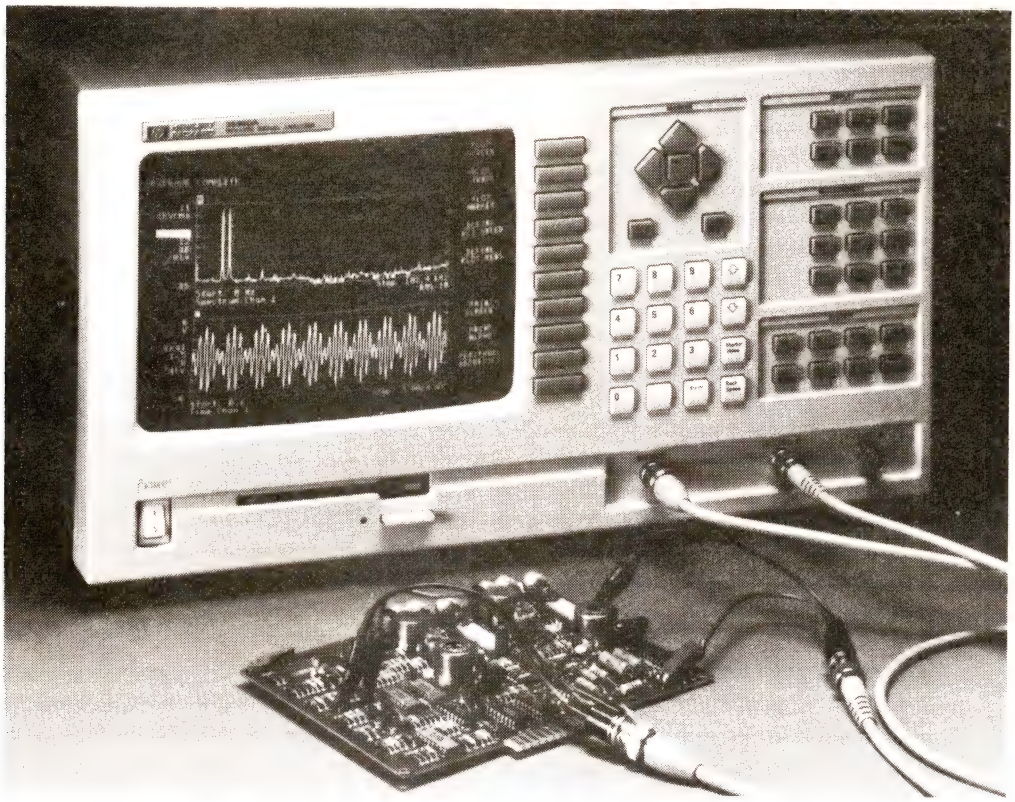
A dynamic signal analyser

Hewlett Packard's new 35660A two-channel dynamic signal analyser includes many test and automation features traditionally requiring the use of an external computer, and has a variety of applications in electronics, mechanical tests, acoustics and other low-frequency areas.

It provides spectrum analysis from dc to 102.4 kHz, network analysis from dc to 51.2 kHz. It also provides 400 lines of resolution in both one-and two-channel modes. Complete alias protection and digital zoom ensure high-resolution measurements with guarantied accuracy, say H-P.

The analyzer has two input channels with 70 dB dynamic range and a source providing signals for stimulus-response testing. It measures linear spectrum, power spectrum, frequency response gain/phase, group delay, time history and power spectral density.

It comes with a built-in 3.5" disc drive, is compatible with HP 9000 Series 200/300 workstations, and stores traces, tables and HP Instrument BASIC programs.



New Shure sound system

Audio Engineers has introduced the Shure Audiomaster, a compact sound system with optional six, eight or ten inputs and featuring a rated 200 watts of output power.

The system consists of the Audiomaster 1200 Mono Powermixer, a mixer/amplifier with six inputs which can be expanded anytime to eight or ten inputs, and an amplifier rated at 200 watts minimum output into 4 Ohm speakers and 120 Watts into 8 Ohm speakers.

It weighs 12 kg, is 179.2 mm high and mounts in a standard 19" rack. There are separate monitor and reverb mixes and concentric EQ controls for each input and monitor mix.

More details from **Audio Engineers, 342 Kent St. Sydney 2000 NSW. (02)29 6737.**

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IN OUR 1,000,000TH FUN WAY KIT!

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IT MUST BE WON. IT COULD BE YOU!

Permit numbers applied for at time of going to press in NSW, Victoria, ACT and NT

STOCK UP THE SHOP!

The workshop, the shack, the toolbox . . . whatever, with these value plus service aids.

Cleaning Solvent

Non corrosive, low toxicity, idea for all sorts of electronic cleaning applications. Cat N-1040

$6.95

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Your switch and relay contacts will love it! Cleans off much, suppresses arcing, reduces wear. Cat N-1042

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Protects pcb's from tarnishing, damage. Solder-through covering makes service easy, too. Cat N-1045

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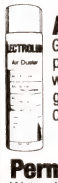
Air Duster

Give dirt, dust etc a high pressure blast – inert gas won't corrode or damage, great in tight corners! Cat N-1050

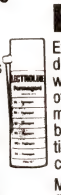
$15.95



Permagard

Water displacer, penetrates to free stuck nuts & bolts, etc. Also protects against corrosion. Cat N-1065

$7.50



COLOURED INSULATION TAPE, TOO

All the colours you need to mark pos/neg, 3 phases, earth, etc. 18 metre rolls, 19mm wide. Colours: Green/Yellow N-1359 Orange N-1360 Red N-1361 Black N-1362 Brown N-1363 Blue N-1364

All One Price:

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SOLDER ON!

Sick of running out of solder: buy in bulk – it lasts and lasts and . . . You'll save money, too! Two gauges, both 200g rolls.

0.71mm (22g) Cat N-1623

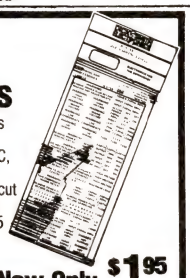
1.25 (17g) Cat N-1619

$6.95/roll

NEW!

WARNING! Bargain Labels

Watch out: there are over 80 labels here in just about everything imaginable – warnings, voltage, AC, DC, fuses, etc, etc, etc, all on an adhesive backed mylar base; just cut out the ones you want & stick 'em where you want. And at only $2.95 that's fantastic value. Cat N-5759



Introductory offer: $1.00 OFF!

Now Only $1.95

Now Hear These...

Superb quality hi-fi speakers you'll be proud to own – and hear! 3 way with massive 300mm woofer, 120mm midrange and 65mm tweeter. Overall size 385×300×725mm. 65W power handling, attractive teak "wood-grain" finish with black grille. Cat A-9500

$329

No More Birdsnests!

Experimentors . . . circuit developers . . . engineers . . . why mess around with the pile of components on the bench; make your prototypes on breadboards – saves a lot of time in the long run! 4 styles to choose from:

Mini: 80 × 60mm, 58 groups of five connected terminal points. Cat P-4614 $10.95

Giant: As above, but 128 groups. 178 x 67mm. Cat P-4615 $8.95

With terminals: 256 groups, +, - & earth terminals too. Cat P4616 $39.95

And a panel: 128 groups, with terminals and front panel for mounting pots, switches etc. Cat P-4617 $24.95

See The Light?

If you need a bezel, look no further. There are some really bright ideas in this lot of quality bezels.

Mini LED: 2 colours, our most popular. Low drain (20mA @ 2V), high visibility.
Red: Cat S-3528
Green: Cat S-3529
Both: $1.50 ea

12V Globe: Used in alarms, etc. High brightness, requires 12V DC or AC. Looks great!
Red: Cat S-3510
Green: Cat S-3512
Both $1.75 ea

Mini Neon: Tiny size, contains neon only (requires series R). High visibility. Cat S-3552 $1.95

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Dual Colour: both red and green LEDs in one bezel. Great when two state indication required. Cat S-3530 $4.75

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Earpieces and Phones at bargain prices:

Save $3 on inside ear mini phones. Quality, yet very tiny. Cat C-4135
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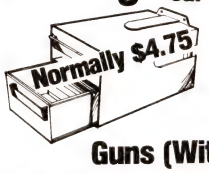
Were $29.95 Now $24.95

Somewhere to PUT IT ALL

Check out these parts drawers: they're great for resistors, capacitors, semis, fish hooks, etc, etc, etc.

2 Drawer Modular

They're stackable: just keep on adding as many modules as you require. And if you add them this month, you'll save! 2 drawers per unit. Cat H-2580 $3.95 ea.



Single Tilt Drawer

Similar to left, but this has one drawer on an axle which allows tilting forward. Cat H-2581

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Now $3.95 ea.

And The Big Guns (With Big Savings!):

A big 290×220×45mm case with internal divider containing multiple sections. Cat H-2596

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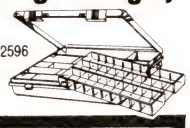
This month $29.95



QUICK! GRABA ZIPPY BOX AND $AVE!

There's only one genuine Zippy box: it's the one with the deep ribbed sides and the genuine Dick Smith Electronics catalogue number moulded into the bottom. Don't be fooled by cheap imitations: insist on the one, the only genuine Zippy Box – exclusive to Dick Smith Electronics.

Now With Aluminium And Plastic Lids!

Small (UB5): 28 x 54 x 83mm Cat H-2855 ~~$2.50~~ $1.95

Medium (UB3): 41 x 68 x 130mm Cat H-2855 ~~$3.50~~ $2.95

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Giant (UB2): 60 x 113 x 196mm Cat H-2855 ~~$5.50~~ $4.95

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What do you do when you're out of reach of a power point. Use a Portasol, of course – the butane powered gas soldering iron that goes where you go.

You know the portasol: here's the PRO model! The complete kit includes: • Portasol PRO Gas Iron • Four tips including hot knife and blow torch • Tip Cleaning Sponge • All in a heavy duty plastic case which doubles as an iron stand! Cat T-1374

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Positions	Poles	Cat No
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3	4	S-6303
4	3	S-6304
5	2	S-6305
6	2	S-6306
12	1	S-6312

Only $2.25 each!

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Here's a handy one: a spec scoop purchase so you kn you'll $ave on the normal pri Mains plug-pack with a 6V D 400mA secondary – perfect for those low voltage projects! Cat M- 9548

Think what you'd normally pa Our price: $6.95

Other Plugpacks:
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3/6/9V @ 200mA (Cat M-95 $16.95
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12V AC @ 500mA (Cat M-95 $29.95
16V AC @ 900mA (Cat M-95 $14.95

WHY WON'T IT SELL?

It would have to be one of the handiest devices anyone working with audio could ever own. It instantly checks cables for go/no go in RCA, Cannon & 6.5mm – without having to worry about meters, etc. But it didn't sell. So we've slashed the price to way below cost to clear 'em out. OK, we lose – but YOU REAP THE BENEFIT of our mistake! Cat Q- 1532

SHOULD BE WAY OVER $60 . . .

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...ject call for an RF choke? ...eck out our great range – ...n a miniscule 1 uH and ...rything in between! All one ..., low price: ...15 each (even cheaper in ...anitity!)

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...H	L-1767	330uH	L-1807
...H	L-1769	470uH	L-1811
...H	L-1771	560uH	L-1813
...H	L-1773	820uH	L-1817
...H	L-1775	1mH	L-1820
...H	L-1779	1.5mH	L-1822
...H	L-1783	2.5mH	L-1824
...H	L-1787	5mH	L-1826
...H	L-1791		

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...mm square self-adhesive ...et – no need to drill holes. ...se on commercial gear, ...o, to prevent scratches! ...ack of 4. Cat H-1749
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Now $1.50

...iOc off ...Connectors

...he no-solder way to join ...ables. Just place them in ...e connector, squeeze with ...liers and: ...resto! Pack of 2 ...at H-6720
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...a nifty two-part cable clamp ...offering high security. Heavy ...uty, pack of five. Cat H-1970
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...fibreglass has all the ...dvantages: stronger, higher ...resistivity, better temperature ...handling, better "abuse" ...handling . . . these days, ...here's no reason to keep ...using bakelite PCB (but if you ...really want it, we have it!). ...Especially when you look at ...the low, low prices of our ...fibreglass PCB blanks. (Want ...to etch your own PCB's? ...Check out the range of DATAK ...PCB making materials at any ...Dick Smith store!)

...Fibreglass blanks:

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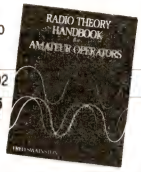
...6 (150x150)	H-5545	$4.95
...12 (150x75)	H-5550	$15.95

NEW BOOKS TO GET INTO . . .

Radio Theory Handbook

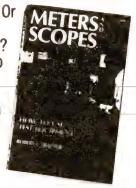
At last! An Aussie book for amateurs – or amateurs to be. Almost 350 pages, compares very favourably with ARRL etc – but it's $10 cheaper! Written to DoTaC syllabus. Cat B-4002



$39.95

Meters & Scopes: How to use Test Equipment

How often have you wondered how to get the best from a CRO. Or dipper. Or even a multimeter? Wonder no more: it's here! Cat B-5000



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Experiments with EPROMs

What they are, how they work and, of course, experiments AND projects to build involving or for treatment of EPROMs – including burners. Cat B-5001

$21.95

AND OLD FRIENDS REVISITED...

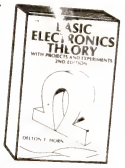
Transistor Equivalents

Probably the most useful book a hobbyist could have (after the Dick Smith Catalogue, of course!) It's been out of stock for a while – so grab one now.

$6.95
Cat B-4507

Basic Electronics Theory

A whopper! 666 pages crammed full of everything you've ever wanted to know about electronics – and then some. Ideal reference work. Cat B-1615



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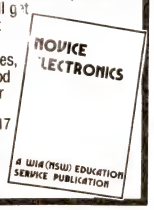
WIA Novice Electronics

Want to get an amateur licence? Start with the Novice Licence and work up: this book will get you that licence. 136 pages, very good value for money. Cat B-2317



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PACKS: THE SMART WAY TO BUY YOUR COMPONENTS!

Use components? There's only one way to buy them: in bulk. You'll make savings of up to 50% and more by buying Dick Smith bulk component packs. No rubbish – just prime spec, guaranteed new components.

100 Premium LEDs

Who'd want 100 LEDs? Anyone who wants more than 40 or so! Because the last half are effectively FREE! You never know when you'll need them! Cat Z-4084

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300 1/4W 1% RESISTORS

Why use carbons when 1% metal films are so cheap – especially in a bulk pack. 300 Computer-selected values between 10 Ohms & 1 meg. Cat R-7015

SAVE OVER $6 **$14.95**

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BIG SAVINGS OVER ONE-OFF

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Have you got your coloured lights all ready for Christmas – it's only a few weeks away (bet that scared the pants off you!). Christmas (and any other) parties take on a whole new atmosphere with the right lights – and here are the right lights:

Par 38 Heavy Duty Pressed Glass
$10.95 ea

Yellow	S-3850
Red	S-3852
Blue	S-3854
Green	S-3856

R95 Light Duty Reflector Globes
$6.95 ea

Yellow	S-3851
Red	S-3853
Blue	S-3855
Green	S-3857

Edison Screw Lampholder to Suit: Cat P-5620 **$7.95 ea**

Hands Up if you can Spell...

Keep your hand up if you can spell with 100% accuracy! The Franklin Spellmaster will turn even the world's worst speller into a superspeller – if you can say the word, you can spell it!

Features:
- 80,000 word dictionary
- Advanced searching and deduction
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- All in the palm of your hand!

It's better than a dictionary (you don't need to know how the word is spelt!), better than a computer with a spelling checker (it's portable). Sensashunal? No, sensational! Cat Y-7305

$199

HOLD IT!

Soldering to batteries is a big no-no. Finish off that project with one of these superb battery holders from Dick Smith Electronics.

1 x "D" Cell Cat P-6101 **70c**
4 x "C" Cells Cat P-6104 **90c**
4 x "AA" Cells, Long Cat P-6114 **75c**
4 x "AA" Cells, Squat Cat P-6124 **70c**
6 x "AA" Cells, Squat Cat P-6116 **95c**
8 x "AA" Cells, Squat Cat P-6128 **$1.20**
10 x "AA" Cells, Squat Cat P-6130 **$1.45**
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LIMITED STOCKS

Sounds Good To You

Quality Mangavox Speakers for replacement in existing enclosures or building new designs. Compare the value, compare the prices, compare the savings!

10IN WOOFER Cat C-2052
Normally $39.95 Now $29.95

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SOMEWHERE OVER THE RAINBOW — YOU'LL SAVE

Rainbow cable is by far the most economic way of buying hookup wire: you've always got the number of conductors you need (up to 12!), and you can peel off as much or as little as you like! And if you buy it by the roll (100m) you'll save even more than normal off our bulk price! **$1.90** per metre, Normally $1.71 per metre in bulk rolls;
THIS MONTH ONLY $1.50 per metre in bulk (100m) rolls.

COMPUTER CORNER

101 Key Keyboard

The cheapest around – but there's no loss of quality! Superb "Alps" keyswitches for reliability, ideal for most IBM compatible computers. Cat X-3821

$149

Floppy Drives

Need a floppy disk drive? We have both popular formats in half height drives, ready to slot into your computer.

360K (Ideal for adding to an AT to give XT compatibility) Cat X-8012 **$229**

1.2Mb (standard "AT" type drive) Cat X-2200 **$269**

Gender Benders

It's always the same; Murphy's Cable Corollary applies; if you have two cables to join, both will have male (or female) plugs or sockets! Gender Benders fix that problem: standard 25pin

"D". Male to Male X-3565

Female to Female X-3566

Each: **$12.95**

Cables, Too...

We have a huge range of ready-made computer cables or the cable, and plugs & sockets to make up your own. Here are just two examples:

Centronics Printer Cable: Standard Centronics plug one end, 25 pin D the other. As used on most computers & printers. Cat X-8614

$24.95

5 Core Data Cable: Shielded 5 core cable with drain wire, perfect for running in buildings for computer LANs, terminals, etc. Cat W-2040

$1.85/m or **$1.65/m** in 100m rolls.

Don't Forget Our Range Of Disks, Ribbons, Plugs, Sockets, Etc Etc Etc

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Using the 555 and its dual, the 556

Roger Harrison

Acknowledged as one of the most versatile and popular ICs ever produced, the 555 timer is an incredibly easy device to use and has found its way into a tremendously wide variety of applications. Once you know how it works and how to use it, it virtually finds applications for itself!

FIRST introduced by Signetics and now made by many major semiconductor manufacturers, the 555 is a tremendous success story in the semiconductor world. Simplicity and predictability are the hallmarks of its success. It can produce accurate and stable time delays and oscillations, and inputs are provided for external triggering and resetting. Just one resistor and one capacitor determine the period in time delay applications; two resistors and a capacitor determine frequency and duty cycle when it's used as an oscillator.

The data sheet following this article gives a complete rundown on the 555's electrical characteristics and specifications, but I'll shortlist some of the main ones here so we have a starting point from which to work. The 555 will operate from supplies ranging over 4.5 volts to 18 volts. The output can supply (source, as they say) or absorb (that is, sink) up to 200 mA and thus will operate relays, LEDs, lamps and buzzers.

As a timer it is useful for periods ranging from a few microseconds to several hundred seconds, the period is virtually independent of supply rail voltage and varies only 0.005% per °C with temperature changes. Both the trigger and reset inputs operate on falling waveforms. Its output pulses typically have rise and fall times of 100 nanoseconds (0.1 µs), and this makes it useful for accurate timing in conjunction with other digital circuitry.

As an oscillator, it can work up to 500 kHz and the output may be frequency modulated or pulse position modulated, which suggests application as an audio alarm generator or audio indicator for some varying quantity. Its output may be used to directly drive a piezo-electric transducer or a loudspeaker.

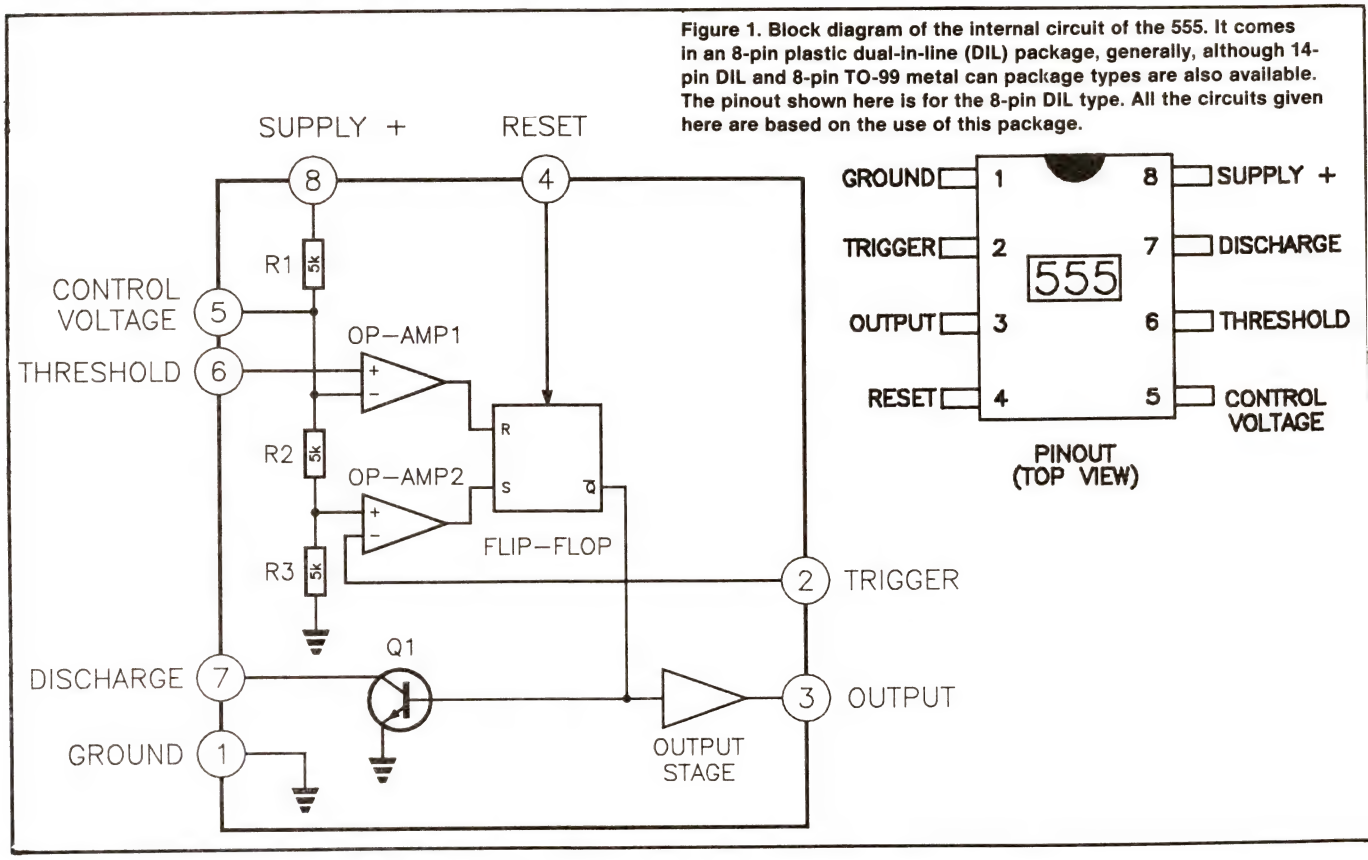


Figure 1. Block diagram of the internal circuit of the 555. It comes in an 8-pin plastic dual-in-line (DIL) package, generally, although 14-pin DIL and 8-pin TO-99 metal can package types are also available. The pinout shown here is for the 8-pin DIL type. All the circuits given here are based on the use of this package.

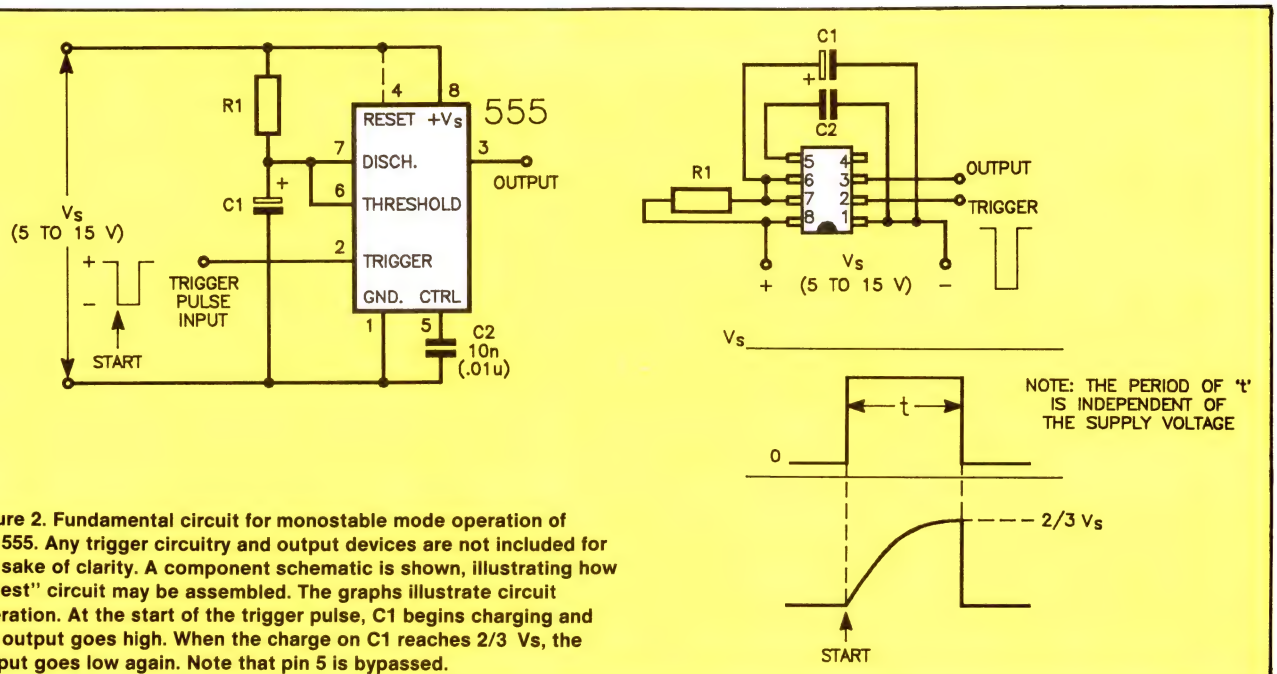


Figure 2. Fundamental circuit for monostable mode operation of the 555. Any trigger circuitry and output devices are not included for the sake of clarity. A component schematic is shown, illustrating how a "test" circuit may be assembled. The graphs illustrate circuit operation. At the start of the trigger pulse, C1 begins charging and the output goes high. When the charge on C1 reaches 2/3 Vs, the output goes low again. Note that pin 5 is bypassed.

Alright, let's get down to the nitty gritty of how the device works as a timer and an oscillator, illustrating its applications with practical circuits you can build.

Inside the 555

The internal block diagram of the 555, and its 8-pin DIL package pinout, are shown in Figure 1. Inside the 555 are 23 transistors, two diodes and 15 resistors. These components are arranged to provide two voltage-comparator op-amps, a reset-set (R-S) flip-flop, a transistor 'slave' and a low power complementary output stage.

A potential divider runs between the supply and ground, comprised of three 5 kΩ resistors, R1-R2-R3. Thus, 2/3 of the supply voltage (2/3 Vs) appears at the junction of the upper two resistors, R1 and R2, and 1/3 Vs appears at the junction of the lower two resistors, R2 and R3. A complete internal circuit of the 555 is given in the accompanying data sheet.

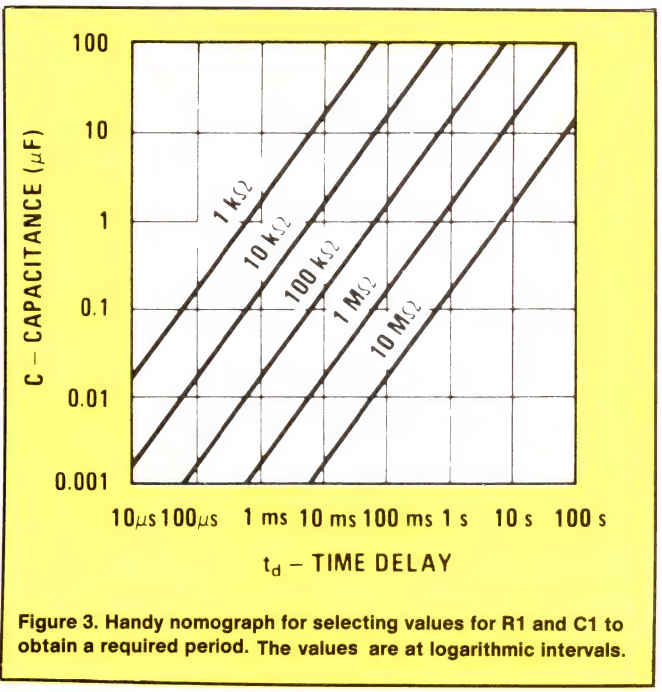


Figure 3. Handy nomograph for selecting values for R1 and C1 to obtain a required period. The values are at logarithmic intervals.

The inverting input of Op-Amp 1 is connected to 2/3 Vs, while the non-inverting input of Op-Amp 2 is connected to 1/3 Vs. The outputs of these two comparators go to the flip-flop R-S control inputs. Only the active-low output of the flip-flop is used and this controls the output stage and the slave transistor, Q1. The state of the flip-flop's output can also be controlled by the 555's "reset" terminal, pin 4; but we'll return to that later.

The junction of R1-R2 is taken to pin 5, labelled "control voltage". The non-inverting input of Op-Amp 1 is taken to pin 6, labelled "threshold", while the inverting input of Op-Amp 2 is taken to pin 2, labelled "trigger". Thus, pins 2 and 6 are the primary control inputs for the flip-flop, which controls the output. Transistor Q1 is used as a switch, its collector being taken to pin 7, labelled "discharge".

The 555 has two fundamental modes of operation: as a *monostable*, or *one-shot*, and as a an *astable multivibrator*. The monostable mode is used for timing applications as the output is activated for a given period in response to a single input pulse. The astable mode is used for oscillator applications as the device is then a free-running oscillator. Let's look at how it works in each of these modes in turn.

How it works — as a timer

In monostable mode, the 555 is fundamentally connected as shown in Figure 2. The trigger input circuitry and output devices are left off for the sake of clarity. The discharge and threshold pins are tied together and connected to the junction of R1 and C1, the components which determine the timing.

With power applied, the flip-flop output is normally high, turning Q1 on and holding the output low. As Q1 is on, its collector-emitter junction short-circuits capacitor C1 to the common line so that it cannot charge. This also holds the threshold pin (6), and thus the non-inverting input of Op-Amp 1 low.

The trigger input is normally held high and a low-going pulse applied. As soon as pin 2 goes low, the flip-flop output changes state, going low. Q1 turns off and the output, pin 3, goes high. Capacitor C1 then begins to charge via R1. Note that it charges exponentially.

When the charge on C1 reaches 2/3 Vs, the non-inverting input of Op-Amp 1 will be at 2/3 Vs and its output will change state. This will cause the flip-flop output to go high again, driving the output, pin 3, low once more, and turning Q1 on. ▷

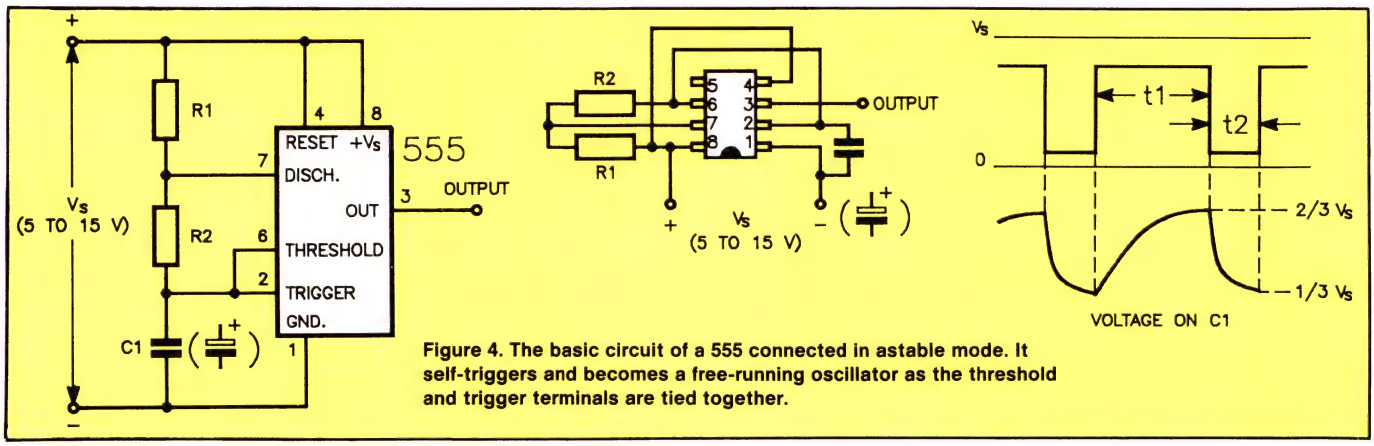


Figure 4. The basic circuit of a 555 connected in astable mode. It self-triggers and becomes a free-running oscillator as the threshold and trigger terminals are tied together.

Q1's collector then shorts C1, discharging it, and the timing cycle is completed.

Because Q1's collector also pulls pin 6 low again, the voltage on the non-inverting input of Op-Amp 1 is then below that on its inverting input and its output goes low again. The trigger input, pin 2, must be taken high again before the end of the output period, setting Op-Amp 2's inverting input high and its output low. These two things re-establish the initial internal conditions for the 555.

The waveforms in Figure 2 show what happens. Since the charge on capacitor C1 and the threshold level of Op-Amp 1 are both directly proportional to the supply voltage, the timing interval is *independent* of the supply voltage. The period is given by:

$$t = 1.1 \times R1 \times C1$$

Thus, if R1 is 1 MΩ, and C1 is 1 µF, the output period will be 1.1 seconds. Figure 3 is a handy nomograph you can use to quickly determine values for R1 and C1 for a required time period between 10 µs and 100 seconds.

Values for C1 and R1 range between 1n and 100µ, and from about 1k to 10M, respectively. Note that C1 must always be a low-leakage component, else timing accuracy may be affected. For values under 1µ, plastic (polyester or polycarbonate) capacitors are ideal, while above 1µ, low-leakage electrolytic capacitors (RBLL or RTLL types) or tantalums should be used unless time periods are not critical, when ordinary off-the-shelf electrolytics are fine.

The 555 only requires a narrow, negative (low-going) trigger pulse to start the timing cycle. This pulse must start at a level above 2/3 Vs and drop below 1/3 Vs. While the output is high, a further trigger pulse will have no effect. However, the output period can be cut short by applying a a low-going pulse to pin 4, the reset input. This resets the internal flip-flop's output high, setting pin 3 high and turning Q1 on. The output, pin 3, will then remain low until another trigger pulse comes along. If this facility is not required, pin 4 should be connected to the supply (Vs), as indicated by the dotted line.

How it works — as an oscillator

To operate the 555 in its astable mode, the device is connected as shown in Figure 4. The threshold and trigger pins are tied together, tying the non-inverting input of Op-Amp 1 to the inverting input of Op-Amp 2.

When power is applied, C1 will commence to charge exponentially via R1-R2. Eventually the voltage on C1 will reach 2/3 Vs. Pin 6, and thus the non-inverting input of Op-Amp 1, will be at 2/3 Vs and its output will change state, changing the state of the flip-flop output. This will turn Q1 on and C1 will commence to discharge exponentially via R2. When the voltage on C2, and thus on pin 2, reaches 1/3 Vs the output of Op-Amp 2 will change state, setting the flip-flop output low. Thus, the output will go high again, Q1 will turn off, allowing C1 to charge again, and the whole cycle repeats. In other words, it behaves as a self-retriggered monostable.

The voltage on capacitor C1 will swing between 1/3 Vs and 2/3 Vs. The charging period (t1 in the waveforms shown in Figure 4) will be determined by the total value of R1 and R2, while the discharge period is determined by R2 alone. By choosing the values you can choose the mark-space ratio. The *mark* period of the output pulse, t1, is determined by:

$$t1 = 0.693(R1 + R2)C1$$

While the *space* period is given by:

$$t2 = 0.693(R2)C1$$

Note that you should use Ohms and Farads, or megohms and microfarads, for a result in seconds.

The total period is simple obtained by adding t1 and t2. To determine the frequency, simply divide this value into 1. Or, the formula comes out as:

$$f = 1.44/(R1 + 2R2)C1$$

You can use the nomograph in Figure 5 to determine suitable values for C1 and R1 + R2. If R2 is relatively large compared to R1 (about 5-10x), the frequency is largely determined by R2 and you can use the nomograph directly.

In practice, the R1-R2 values can be varied from around 1000 Ohms to tens of megohms. However, the value of R1 greatly affects current consumption, if that's a consideration, since pin 7 is shorted to common by Q1 during the discharge period of the timing sequence. The mark-to-space ratio can be preset at a non-symmetrical value by suitable choice of values for R1 and R2.

Next month, now we've found out how the 555 works, we'll get down to showing some practical circuits you can build.

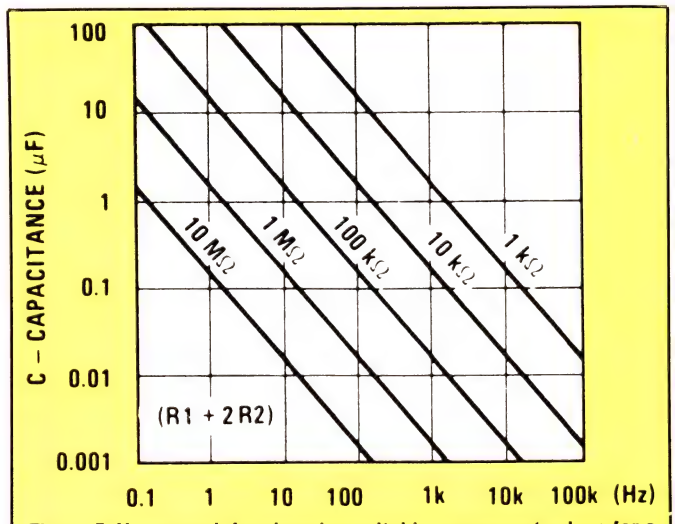
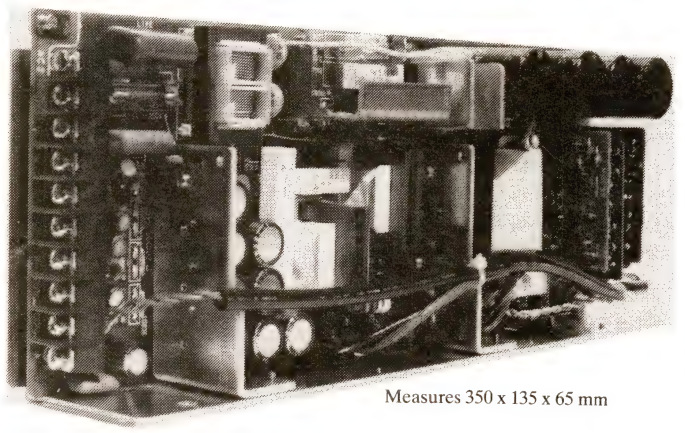


Figure 5. Nomograph for choosing suitable component values for a required frequency of oscillation in the astable mode.

. . . . . PSST!



Measures 350 x 135 x 65 mm

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Output D: –12 V, 0.4-1.5 A*
Output E: –5 V, 0-1 A

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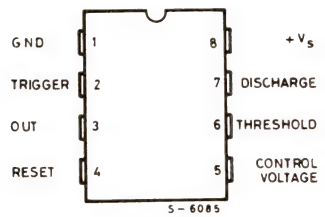
NE555
SA555
SE555

TIMER

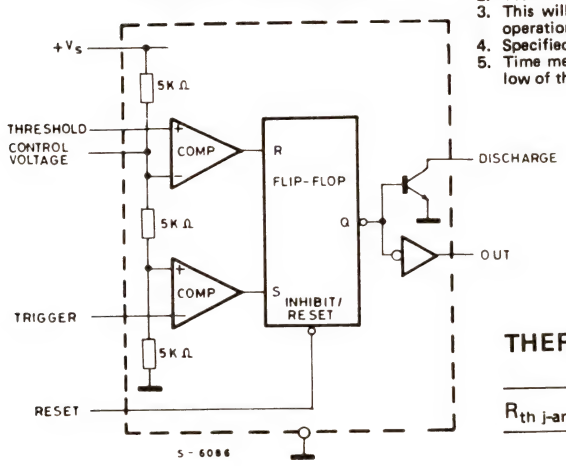
- TURN OFF TIME LESS THAN 2μs
- MAXIMUM OPERATING FREQUENCY GREATER THAN 500kHz
- TIMING FROM MICROSECONDS TO HOURS
- OPERATES IN BOTH ASTABLE AND MONOSTABLE MODES
- HIGH OUTPUT CURRENT
- ADJUSTABLE DUTY CYCLE
- TTL COMPATIBLE
- TEMPERATURE STABILITY OF 0.005% PER °C

The NE555 monolithic timing circuit is a highly stable controller capable of producing accurate time delays or oscillation. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, the free running frequency and the duty cycle are both accurately controlled with two external resistors and one capacitor. The circuit may be triggered and reset on falling waveforms, and the output structure can source or sink up to 200mA. The NE555 is available in plastic and ceramic Minidip package and in a 8-lead micropackage version.

CONNECTION DIAGRAM
(top view)



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

V_s	Supply voltage for **SE555**	18	V
	for **NE555**	16	V
T_{op}	Operating temperature range for **NE555**	0 to 70	°C
	for **SA555**	-40 to 85	°C
	for **SE555**	-55 to 125	°C
T_j	Junction temperature	150	°C
T_{stg}	Storage temperature range	-65 to 150	°C

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C, V_s = 5 to 15V unless otherwise specified)

Parameter		Test conditions	NE555			SE555			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
V_s	Supply voltage		4.5		16	4.5		18	V
I_s	Supply current (low state) (1)	V_s= 5V R_L=∞ V_s= 15V R_L= ∞		3 10	6 15		3 10	5 12	mA mA
E_{tm}	Timing error (monostable) Initial accuracy (2) Drift with temperature Drift with supply voltage	R_A= 2 to 100KΩ C= 0.1μF		1 50 0.1	3 0.5		0.5 30 0.05	2 100 0.2	% ppm/°C %V
E_{ta}	Timing error (astable) Initial accuracy (2) Drift with temperature Drift with supply voltage	R_A, R_B= 1 to 100KΩ C= 0.1μF V_{cc}= 15V		2.25 150 0.3			1.5 90 0.15		% ppm/°C %/V
V_C	Control voltage level	V_s= 15V V_s= 5V	9 2.6	10 3.3	11 4	9.6 2.9	10 3.3	10.4 3.8	V V
V_T	Threshold voltage	V_s= 15V V_s= 5V	8.8 2.4	10 3.3	11.2 4.2	9.4 2.7	10 3.3	10.6 4.0	V V
I_T	Threshold current (3)			0.1	0.25		0.1	0.25	μA
VTR	Trigger voltage	V_s= 15V V_s= 5V	4.5 1.1	5 1.67	5.6 2.2	4.8 1.45	5 1.67	5.2 1.9	V V
I_{TR}	Trigger current	V_{TR}= 0		0.5	2		0.5	0.9	μA
V_R	Reset voltage (4)		0.4	0.7	1	0.4	0.7	1	V
I_R	Reset current	V_R= 0		0.4 0.1	1.5 0.4		0.4 0.1	1 0.4	mA mA
V_{OL}	Output voltage (low)	V_s= 15V I_{SINK}= 10mA I_{SINK}= 50mA I_{SINK}= 100mA I_{SINK}= 200mA V_s= 5V I_{SINK}= 8mA I_{SINK}= 5mA		0.1 0.4 2 2.5 0.3 0.25	0.25 0.75 2.5 0.4 0.35		0.1 0.4 2 2.5 0.1 0.05	0.15 0.5 2.2 0.25 0.2	V V V V V V
V_{OH}	Output voltage (high)	V_s= 15V I_{SOURCE}= 200mA I_{SOURCE}= 100mA V_s= 5V I_{SOURCE}= 100mA	12.75 2.75	12.5 13.3 3.3	 	13 3	12.5 13.3 3.3	 	V V V
t_{off}	Turn off time (5)	V_{RESET}= V_s		0.5			0.5	2	μs
t_r	Rise time of output			100	300		100	200	ns
t_f	Fall time of output			100	300		100	200	ns
I_L	Discharge leakage current			20	100		20	100	nA

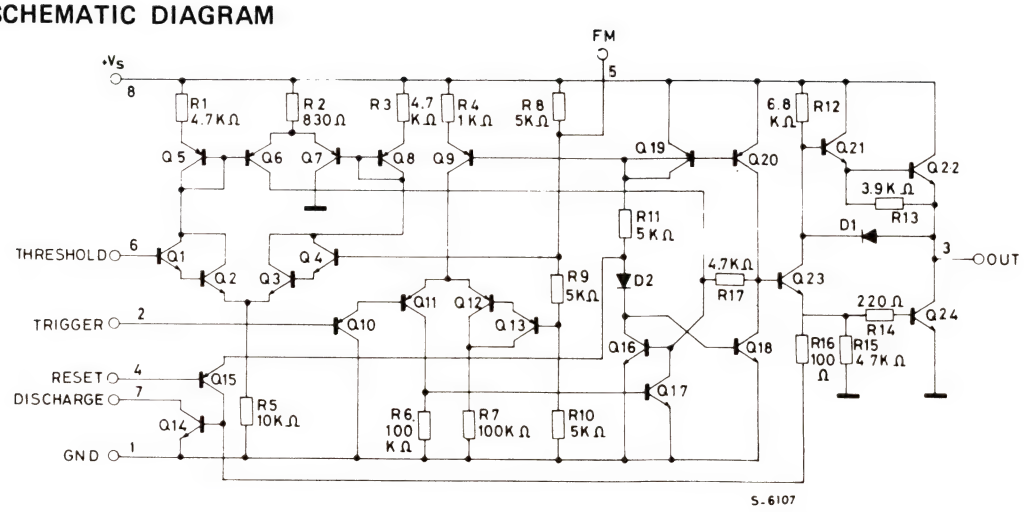
NOTES

1. Supply current when output high typically 1mA less.
2. Tested at V_s = 5V and V_s = 15V
3. This will determine the maximum value of R_A + R_B, for 15V operation, the max total R = 10MΩ, and for 5V operation, the max total R= 3.5MΩ.
4. Specified with triggered input high.
5. Time measured from a positive going input pulse from 0 to 0.8 x V_s into the threshold to the drop from high to low of the output. Trigger is tied to threshold.

THERMAL DATA

			Plastic Minidip	Ceramic Minidip
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max.	120°C/W	150°C/W

SCHEMATIC DIAGRAM



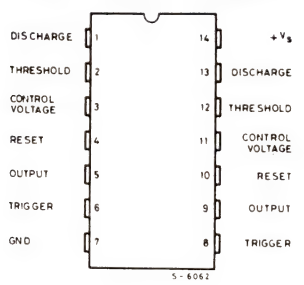
NE556
SA556
SE556

DUAL TIMER

- TURN OFF TIME LESS THAN 2μs
- MAXIMUM OPERATING FREQUENCY GREATER THAN 500kHz
- TIMING FROM MICROSECONDS TO HOURS
- OPERATES IN BOTH ASTABLE AND MONOSTABLE MODES
- HIGH OUTPUT CURRENT
- ADJUSTABLE DUTY CYCLE
- TTL COMPATIBLE
- TEMPERATURE STABILITY OF 0.005% PER °C

The NE556 dual monolithic timing circuit is a highly stable controller capable of producing accurate time delays or oscillation. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, the free running frequency and the duty cycle are both accurately controlled with two external resistors and one capacitor. The circuit may be triggered and reset on falling waveforms, and the output structure can source or sink up to 200mA. The NE556 is available in plastic and ceramic package and in a 14-lead micropakage version.

CONNECTION DIAGRAM



ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C, V_s = 5 to 15V unless otherwise specified)

Parameter		Test conditions	NE556/SA556			SE556			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
V_s	Supply voltage		4.5		16	4.5		18	V
I_s	Supply current (low state) (1)	V_s= 5V R_L=∞		6	12		6	10	mA
		V_s= 15V R_L= ∞		20	30		20	24	mA
E_{tm}	Timing error (monostable)	R_A= 2 to 100KΩ							
	Initial accuracy (2)	C= 0.1μF		1	3		0.5	2	%
	Drift with temperature			50			30	100	ppm/°C
	Drift with supply voltage			0.1	0.5		0.05	0.2	% V
E_{ta}	Timing error (astable)	R_A, R_B= 1 to 100KΩ							
	Initial accuracy (2)	C= 0.1μF V_{cc}= 15V		2.25			1.5		%
	Drift with temperature			150			90		ppm/°C
	Drift with supply voltage			0.3			0.15		%/V
V_C	Control voltage level	V_s= 15V	9	10	11	9.6	10	10.4	V
		V_s= 5V	2.6	3.3	4	2.9	3.3	3.8	V
V_T	Threshold voltage	V_s= 15V	8.8	10	11.2	9.4	10	10.6	V
		V_s= 5V	2.4	3.3	4.2	2.7	3.3	4.0	V
I_T	Threshold current (3)			0.1	0.25		0.1	0.25	μA
VTR	Trigger voltage	V_s= 15V	4.5	5	5.6	4.8	5	5.2	V
		V_s= 5V	1.1	1.67	2.2	1.45	1.67	1.9	V
I_{TR}	Trigger current	V_{TR}= 0		0.5	2		0.5	0.9	μA
V_R	Reset voltage (4)		0.4	0.7	1	0.4	0.7	1	V
I_R	Reset current	V_R= 0		0.4	1.5		0.4	1	mA
				0.1	0.4		0.1	0.4	mA
V_{OL}	Output voltage (low)	V_s= 15V							
		I_{SINK}= 10mA		0.1	0.25		0.1	0.15	V
		I_{SINK}= 50mA		0.4	0.75		0.4	0.5	V
		I_{SINK}= 100mA		2	2.5		2	2.2	V
		I_{SINK}= 200mA		2.5			2.5		V
		V_s= 5V							
		I_{SINK}= 8mA		0.3	0.4		0.1	0.25	V
		I_{SINK}= 5mA		0.25	0.35		0.05	0.2	V
V_{OH}	Output voltage (high)	V_s= 15V							
		I_{SOURCE}= 200mA		12.5			12.5		V
		I_{SOURCE}= 100mA	12.75	13.3		13	13.3		V
		V_s= 5V							
		I_{SOURCE}= 100mA	2.75	3.3		3	3.3		V
t_{off}	Turn off time (5)	V_{RESET}= V_s		0.5			0.5	2	μs
t_r	Rise time of output			100	300		100	200	ns
t_f	Fall time of output			100	300		100	200	ns
I_L	Discharge leakage current			20	100		20	100	nA

THERMAL DATA

			Ceramic DIP-14	SO-14	Plastic DIP-14
$R_{th\,j\text{-}amb}$	Thermal resistance junction-ambient	max.	150°C/W	165°C/W	200°C/W

ABSOLUTE MAXIMUM RATINGS

V_s	Supply voltage for **SE556**	18	V
	for **NE556**	16	V
T_{op}	Operating temperature range for **NE556**	0 to 70	°C
	for **SA556**	-40 to 85	°C
	for **SE556**	-55 to 125	°C
T_{stg}	Storage temperature range	-65 to 150	°C
T_j	Junction temperature	150	°C

Clean power from coal

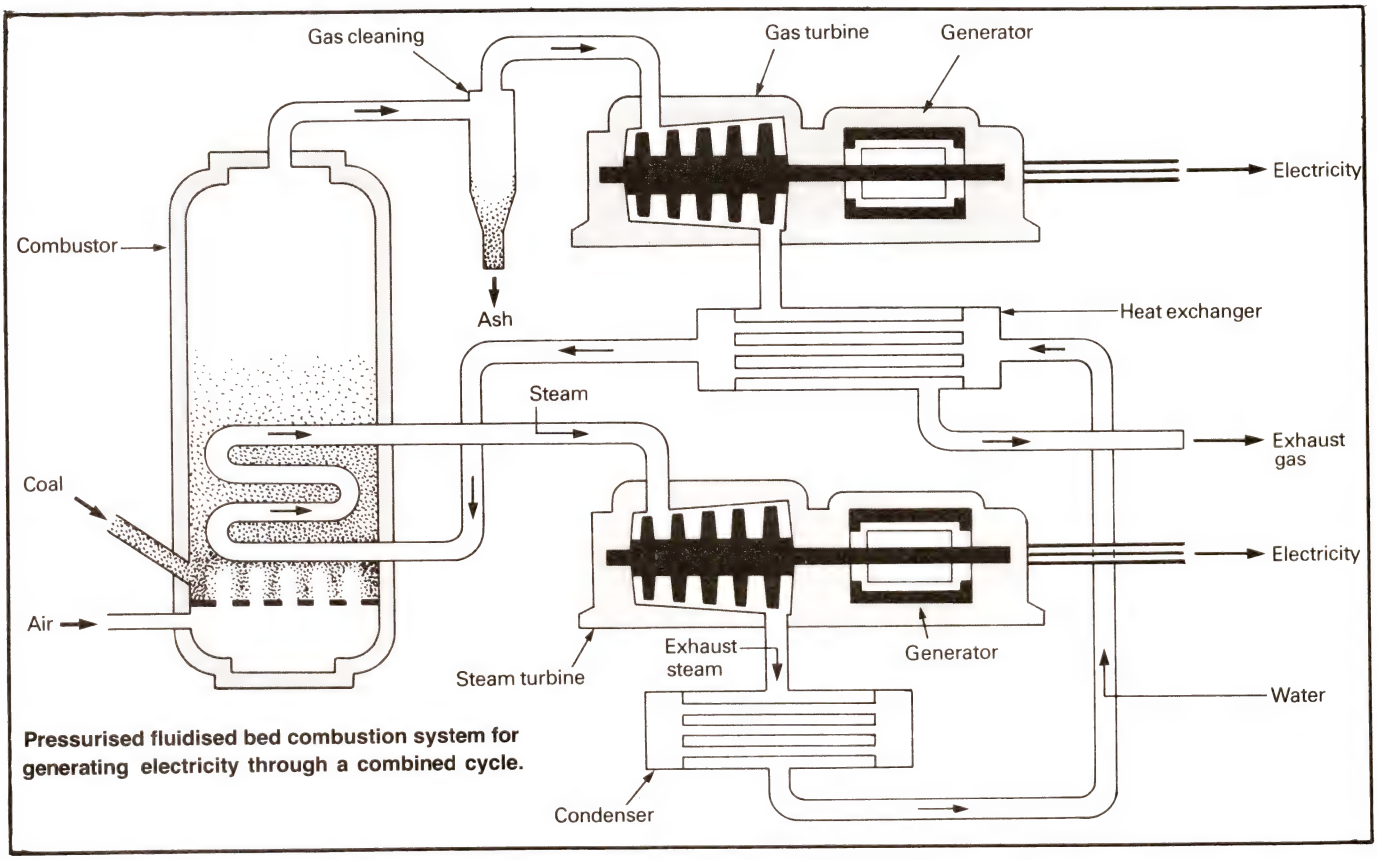
Dr Tom Gibbons and Dr Stuart Saunders
Materials Application Division, National Physical Laboratory, London

Industrialised western society runs on electricity. But the pollution produced by coal-burning power stations is of increasing concern throughout the western world. In many places, it the only real economic or acceptable alternative to other means of power generation. New ways of burning coal using *pressurised fluidised bed combusion* and other techniques offer hope for the future.

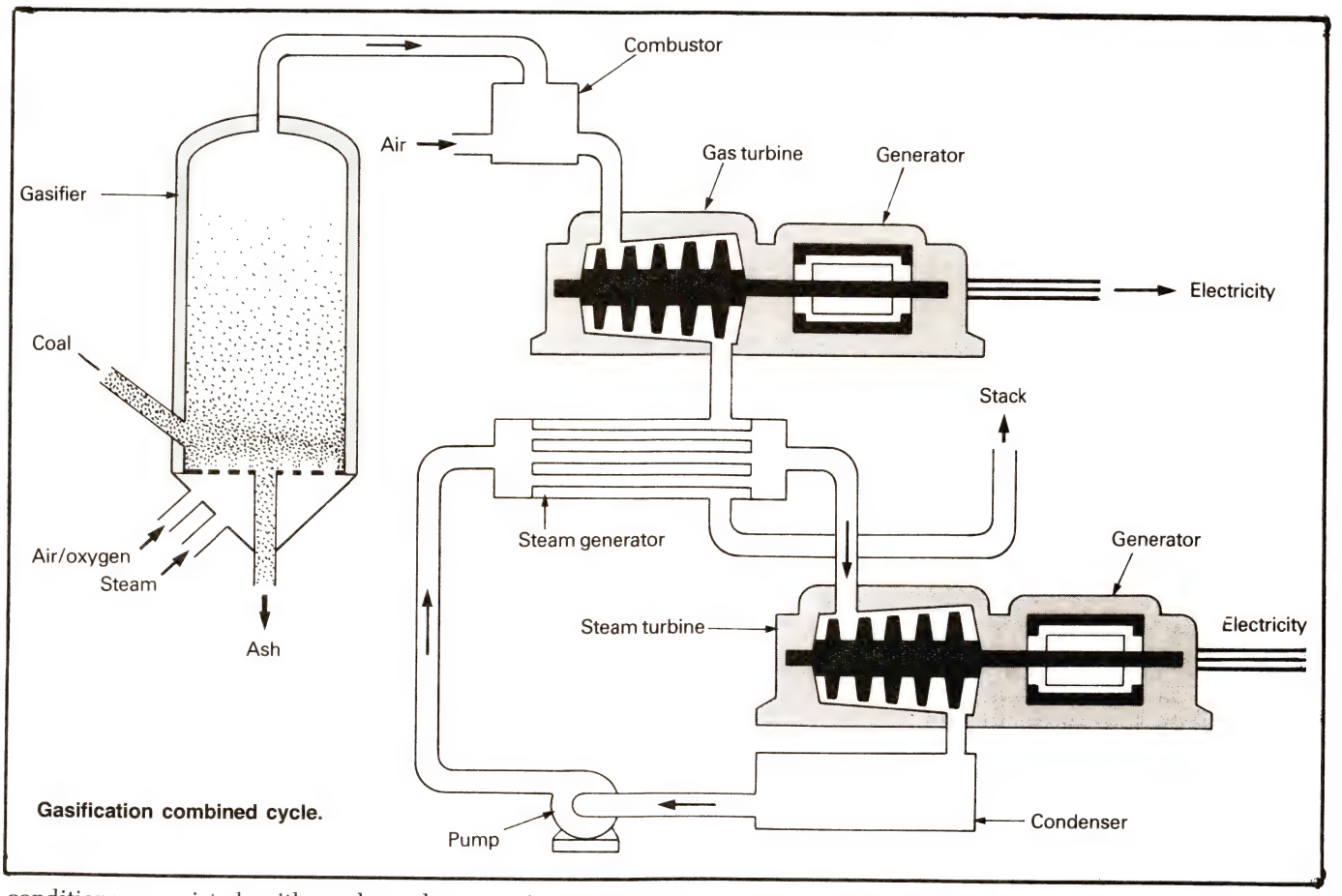
IF SOME some of the ideas now afoot for producing electricity from coal using pressurised fluidised bed combustion (pfbc) or gasification develop beyond the demonstrator stage, the power station of the future will look very different to those we are familiar with today. The attraction of these new technologies for burning coal lies in the thermodynamic efficiency obtainable from combined cycle operations with gas and steam turbines. Emissions of oxides of Nitrogen (NO_x) are reduced because the combustion is at a lower temperature and oxides of sulphur (SO_x) can be readily controlled by adding limestone to the bed.

In conventional power plant consuming oil or pulverised coal, high pressure steam from the boiler is expanded through steam turbines which drive the generators to produce electricity. When techniques such as pbfc or gasification are used, power will be produced most effiently by a combined cycle using both steam and gas turbines. Typical layouts, illustrated, show that in the case of pbfc the hot combustion gas is expanded through a gas turbine and steam for the steam turbine is produced by heat exchangers in the combustor. The cycle envisaged for the gasification system is similar in principle, as is shown.

Although the advantages of these 'environmentally friendly' systems could be considerable, commercial exploitation beyond the demonstator stage will need critical metallic components to perform well enough in the tough



Pressurised fluidised bed combustion system for generating electricity through a combined cycle.



Gasification combined cycle.

conditions associated with such coal conversions technologies. Output gases fromn a pfbc will contain particles (known as particulates) which, if unchecked, will cause serious problems of erosion and/or fouling of the turbine blades. So considerable care has to be taken in filtering the combustion gases; the use of cyclones, ceramic bag filters and/or tube (candle) filters is being studied.

One advantage of the gasification system is that more extensive cleaning may be possible, because the gas may be scrubbed to lower the content of particulates and to reduce the amount of contaminants. Three types of gasification plants have been proposed, namely *entrained flow*, *fluidised bed* and *fixed bed*; large-scale demonstration plants of each type are already working.

An important requirement for entrained flow and fluidised bed plants is a raw gas heat exchanger to extract the sensible heat from the gas before it is cleaned and combusted in the turbine. To achieve overall gains in efficiency comparable with competing systems the gas turbine entry temperature should be at least 1250 °C. Although these conditions are routinely achieved in aero-engines, the more arduous operating conditions of industrial installations present greater demands. There are challenging problems for the corrosion engineer and metallurgist, and a great deal of effort is being made in many countries to find economic solutions that will allow these technologies to develop as commercially viable options for generating electrical power.

Selecting alloys

A basic difficulty faced by all potential manufactures of advanced coal conversion equipment is selecting the most appropriate alloys for long-term performance in severe conditions. Pilot plant and demonstrator tests provide opportunities for assessing the performance of materials in conditions typical of service; but this type of testing is expensive and exposures are usually for only a few hundred hours.

In practice, combined cycle plant will be required to operate reliably for several years, which means 100 000 hours or more. So there is a need to develop a capability for predicting the long-term performance of candidate materials from the results of relatively short-term tests which might be done in the laboratory, to provide the design engineer with the sort of information needed for selecting materials and constructing and operating plant. The key requirement in this type of approach is a knowledge of the mechanistics of corrosion and erosion attack in relevant conditions, because reliable predictions of how an alloy will behave can be made only if there is reasonable confidence that the processes are similar in the laboratory and in service.

Recent work at the UK National Physical laboratory (NPL), in a collaboration with British Coal, has been aimed at understanding the corrosion processes to do with certain components in pfbc and gasification plant. We needed to assess how far a knowledge of corrosion mechanisms would enable test procedures to be developed, reproducing in the laboratory the type of corrosion morphologies observed in components exposed in pilot-plant operations.

In trials with atmospheric fbcs it was evident that the limestone additions, used to absorb sulphur, formed deposits on the heat exchanger tubing, and that corrosion of the underlying metal could be caused by this sulphur-rich deposit. Also, in gasification, although the reactor vessel ▷

We bring you this article because the production of energy is one of the major technological foundations of our society, and an essential component of any electronics activity – something we all take for granted – but it's also a major contributor to atmospheric pollution, now becoming a major public concern. Despite the academic tone and language, we think you'll find it interesting and informative.

	Conventional pulverized fuel plant	Conventional pulverized fuel and fuel-gas desulphurisation	Pressurised fluid-bed combustion combined cycle	Gasification combined cycle
Efficiency (per cent)	38.5	37.3	40.6	39
SO_2/SO_3 removal (per cent)	0	90	90	90
NO_x (parts in 10^6 by volume)	400 to 600	400 to 600	50 to 300	less than 50

Estimated power generation efficiencies and emission of various systems for producing electricity. In gasification, the gas turbine inlet temperature is taken as 1250°C.

would be lined with resistant materials the heat exchanger material would be metallic and exposed to reducing atmospheres at high temperature up to 900°C; deposits of carbonaceous material were also likely to be present. In view of the critical nature of these heat exchanger components to the commercial success of both types of process, the work at NPL has concentrated on examining the corrosion behaviour of candidate materials for these applications, with particular emphasis on the influence of deposits on the corrosion process.

Laboratory testing has been carried out in carefully controlled conditions in the temperature range 650-900°C for pfbc materials and 450-750°C for gasification materials. In each case gas mixtures have been chosen to give selected values of sulphur and of oxygen partial pressure to simulate conditions experienced in service. After exposure for times up to 1000 hours, the samples were examined metallographically and the corrosion morphologies (that is, the form and structure of the corrosion) were compared with those observed on tubular components removed after exposure in the pilot plant systems operated by British Coal.

Calcium sulphate for the pfbc materials laboratory results have shown that deposits can influence the corrosion process. It has been established that, for the alloys considered, no signifigant corrosion attack occured in the absense of deposits at temperatures below 900°C. However, when calcium deposits of the type that form when limestone additions are made to the fluidised bed were in contact with the metal surface in an environment with a low oxygen and high sulphur potential, there was extensive corrosion attack at 750°C. Metallographic examination confirmed that sulphurdation attack had occurred with evidence of sulphide particles penetrating to a depth of about 20 μm even after exposures of only 500 hours.

In alloys operating at high temperatures, protection from corrosive attack depends on the formation of a continuous oxide layer (usually $Cr_2 O_3$) on the metallic surface. Detailed metallographic analysis, using the latest techniques in X-ray mapping, showed that when a deposit was present a solid-state interaction could occur, which led to the degradation of the protective oxide and encouraged the sulphur to get in. Further investigation in the laboratory showed that this solid-state interaction required the stimulus of trace amounts of chloride or of alkaline metals, such as potassium or sodium; so these trace elements, which are always present in coal combustion products were an essential feature of the degradation process.

A further consideration is the porosity of the deposit itself. In the pilot plant studies conducted by British Coal at atmospheric pressure, several different types of coal have been burnt; the type can influence the nature of the deposit formed, particularly the porosity. Studies of the effect of the deposit porosity have led to the identification of an alternative mechanism to explain sulphur penetration in heat exchanger materials. Entrapment of sulphur-containing gases in the micropores of high porosity deposits can lead to a considerable local concentration of sulphur as the oxygen component of the gas mixture is consumed by reaction with the underlying metal.

This locally high sulphidising potential can lead to the protective oxide breaking down and letting in sulphur. It

Micrograph of cross-section through deposit and alloy (of heat exchanger material) after exposure in a fluidised bed combustor.

appears from this work that combustion of coals with high ash-fusion temperatures, which tends to result in porous deposits on the tubing, is inherently more likely to cause sulphidation attack. Nevertheless it is possible that some protection could be gained if a modification of the start-up procedure to promote the formation of a dense deposit adjacent to the tube surface could be achieved.

Gasification

By comparison, heat exchanger components in gasification plant have to operate in even harsher environments, including highly reducing gases and deposits of coal fines, elutriated from the gasifier. In these reducing conditions the partial pressure of oxygen is so low that few oxides are stable. The work at NPL has shown that metallic materials, based on the composition of the Fecralloy steels, which from highly stable surface oxides containing aluminium are resistant to this harsh environment. The stability and protective nature of these oxides at 450°C is enhanced by the presence of small amounts of silicon.

The rare earth element Yttrium, normally added to stabilise oxide layers at high temperatures is, however, detrimental. Exposing these materials in sulphide-containing and chloride containing environments at low partial pressures of oxygen, to simulate typical service conditions, has shown that rates of sulphidation are tolerable and would probably not lead to excessive metal loss during the operating lifetime of the plant.

Thermal expansion

An interesting observation has to do with behaviour in thermal-cycling conditions where oxide decohesion and spalling (flaking-away of the surface) often take place because of the difference in thermal expansion between the oxide and the substrate. With stainless steels the rate of corrosion decreased when thermal-cycling was applied at low temperatures (450°C); this is believed to be associated with debonding of the oxide from the underlying substrate and a consequent breaking of the diffusion path. It is speculated that because the maximum temperature is not

• to page 54. ▷

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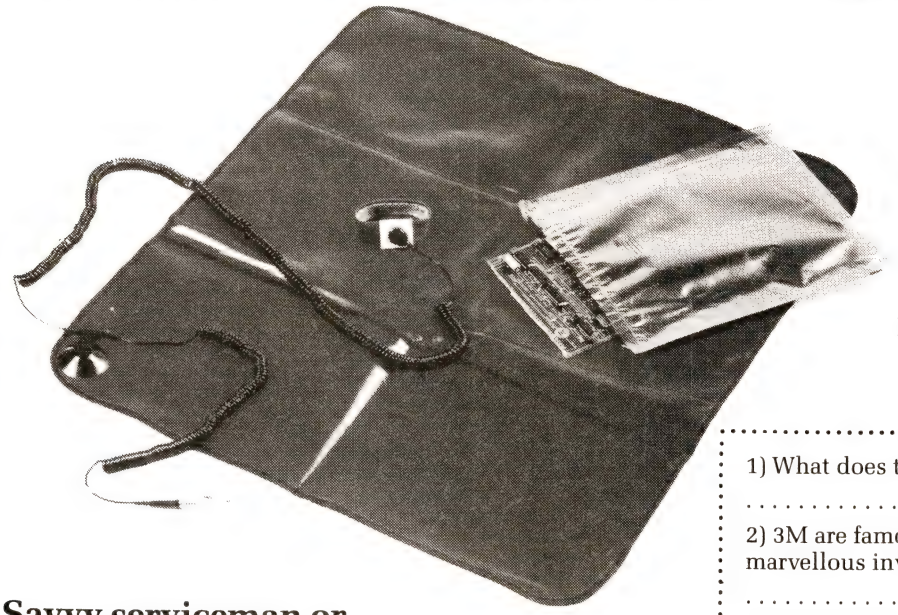

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The Field Service Kit provides a safe area on which to service sensitive components and assemblies, while reducing the risk of sparking or shorting which can occur with other, highly conductive mats.

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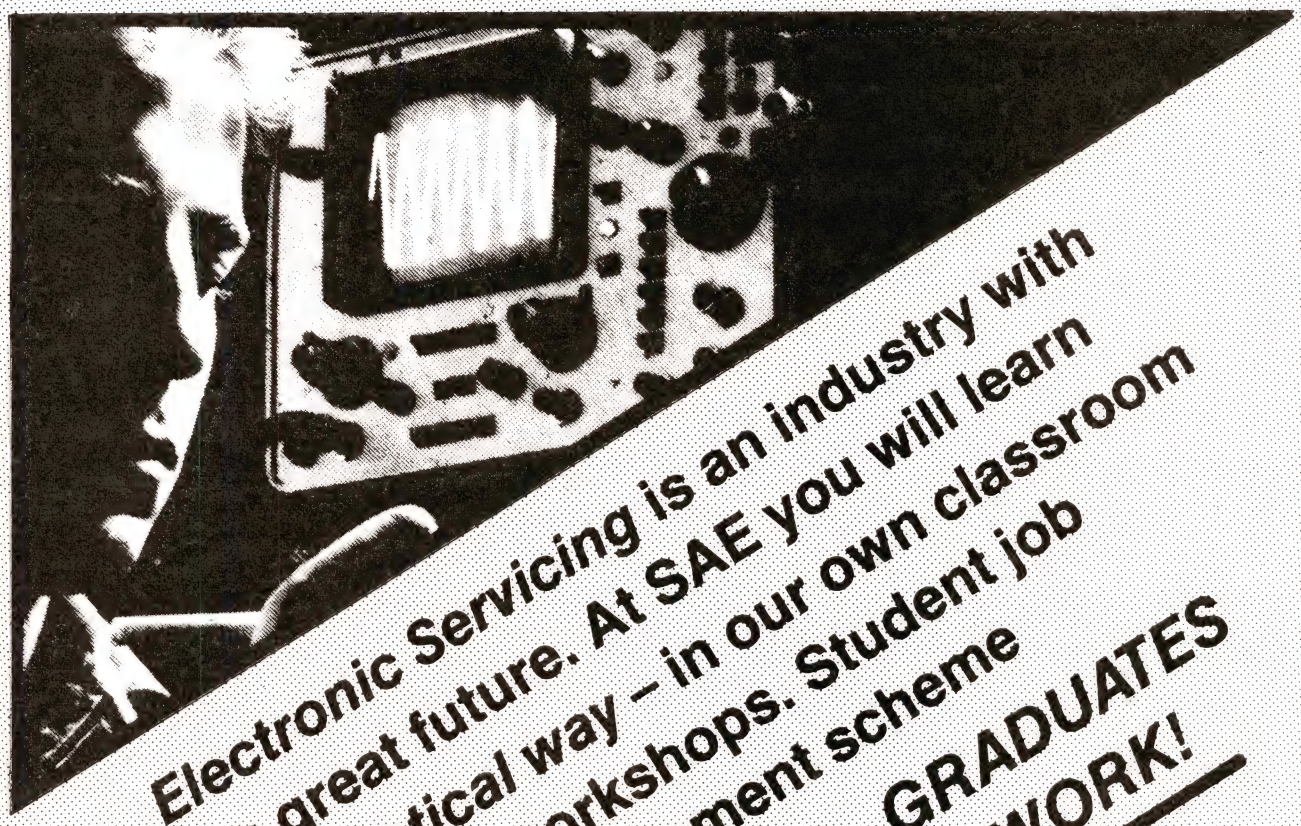

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The importance of temperature control in soldering processes

Roger Harrison

Soldering is a complex metallurgical process on which the success or failure of most electronics assemblies depends, be they mass produced products or hand-built. In servicing, the desoldering process is just as important as the the remaking of joints during repairs.

SOLDER is a remarkable alloy composed, as you know, of tin and lead mixed in a specific ratio such that the melting point of the alloy is less than that of either metal alone. Combined in the ratio of 63% lead to 37% tin, it has a sharply defined melting point of 188 °C where it goes from solid to liquid with no "plastic" range. It is described as a *eutectic* alloy.

In practice, solder for electronics has a 60% lead, 40% tin composition with some minor additives. It goes liquid around 180°-200° C (360°-390° F), and has a small "plastic" temperature range where it is not solid, but not properly liquid either.

Reliable soldered joints have been a goal of the radio-electronics industry since its inception. Reliability has become increasingly important since the widespread introduction of solid state electronics, and particularly so with increasing miniaturisation. Control of the soldering and desoldering processes in electronics work is crucial to equipment reliability. Essentially, this translates to control of the temperature range, and it's just as important during hand soldering (and desoldering) as it is with automated soldering processes such as wave soldering machines, vapour phase and reflow soldering equipment (See *Soldering in the Electronics Industry*, July '86 issue).

The process

Assuming the two parts to be joined are adequately clean such that the soldering flux will dissolve any surface oxides etc, the parts have to be raised to a temperature that gives adequate "wetting" when the solder is applied. Their temperature has to be above the liquid-plastic temperature range of the solder, but not substantially so in order that the parts are not damaged during the process. The "ideal" wetting temperature range is regarded as 240°-270° C (470°-520° F). An intermetallic bond forms between the components being joined and the solder because the copper of the parts being joined "dissolves" in the tin of the solder.

The diagram here shows representative temperature characteristics of various types of hand soldering irons under "working" conditions. Note where the recommended wetting temperature range occurs. The curves marked "CT6" and "CT7" refer to temperature controlled irons.

In automated or semi-automated soldering equipment, temperature control is carefully exercised; wave soldering machines have a substantial mass of solder which is relatively easily maintained within the required temperature range owing to its large thermal mass. Reflow soldering employs controlled infra-red radiation while vapour phase machinery employs a liquid which generates a vapour which is readily maintained within the required temperature range.

Heat stability in these machines is controlled by a feedback process where the working temperature is measured and the power applied is controlled so as to maintain the working temperature within a predetermined narrow range. The board with the assembled components is preheated to raise its temperature and reduce the thermal "shock" that would otherwise occur.

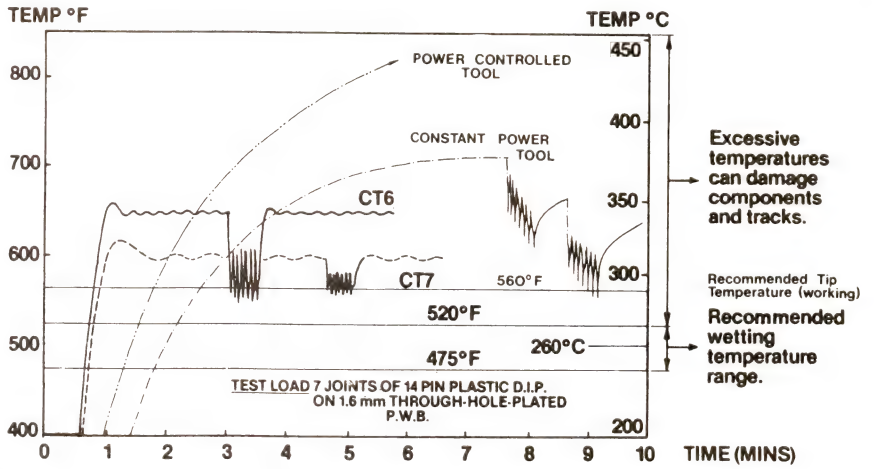
In hand soldering, you don't have such luxuries. The thermal mass of the iron's tip is small and preheating unavailable. Some skill is required, the level of skill depending on the class of soldering iron being used and the operator's experience.

Temperature damage

Today's components and printed circuit boards are readily damaged by excess heat applied during soldering or desoldering. The pads on a pc board are easily "delaminated", or lifted, by the application of excess heat. On a double-sided, through-hole plated board the damage may be within the hole and not visible on the surface of either side.

As mentioned earlier, copper is soluble in the tin portion of solder, which is what creates the intermetallic bond. When the soldering iron is applied for too long, and the temperature is too high, the intermetallic layer of the joint increases, reducing the joint's mechanical strength and durability.

If an iron tip is at too high a temperature, a fine copper track on a pc board ▷



Showing the tip temperature characteristics of different irons under "working" conditions, and where the recommended wetting temperature range falls. (Courtesy Royel)

100 MODELS!

The European company Ersa patented the world's first electric soldering iron in 1928. Since then the company has grown to a position where today, they offer arguably the world's largest single-manufacturer range of soldering equipment. In soldering irons they offer over 100 models from 5 W through to 750 W, along with 10 different models of desoldering irons. They also have static solder baths, wave soldering machines and infra-red reflow solder machines. They are represented in Australia by Meltec (02)708 4300.

The well-known Weller range of irons, from the Cooper Tools Group, include a number of temperature controlled models. This is the Temtronic EC3001D station which features tip temperature control, presettable between 150 and 450 degrees, employing proportional control and zero voltage switching. Cooper Tools claim the proportional control ensures the iron operates within mil. spec.

may be entirely swallowed up in the solder!

The flux in resin-cored solders does not work correctly if overheated. When the solder is heated, the flux melts before the solder does as the flux's solvent, usually alcohol, and the resin (with "activators") has a much lower melting point. The melting flux boils off the surface oxides and other contaminants. If the temperature rises too far, the activators in the resin volatilise too quickly to be effective and the resin decomposes and proper wetting may not take place.

Likewise, too low a temperature does not allow proper time for the flux to do its job or enough time for the solder to be properly liquid and again, wetting is poor.

Components may be affected by too high temperatures during soldering, some types being more prone to problems than others.

Some ceramic capacitors, in particular, are prone to problems in this regard. The electrodes are layers of silver with leads terminated by soldering. With excessive heat, the internal solder reflows and can absorb some of the silver, affecting the component's value. Both temperature and ▷

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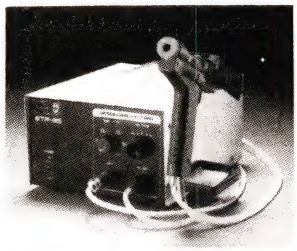

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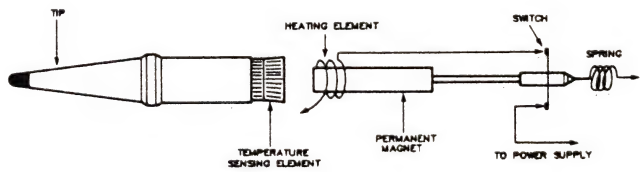


Figure 1. The 'Curie point temperature' iron tip temperature control system, widely employed in Weller temperature-controlled irons.

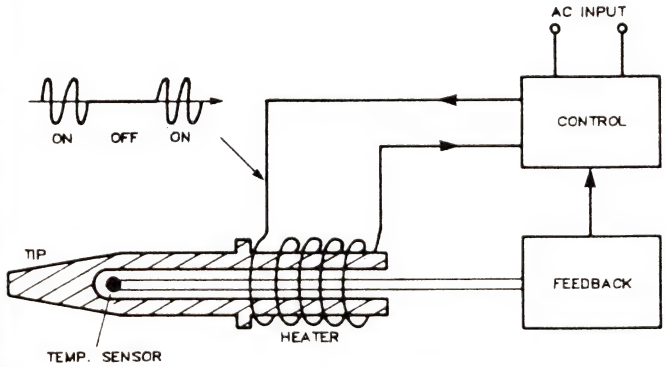


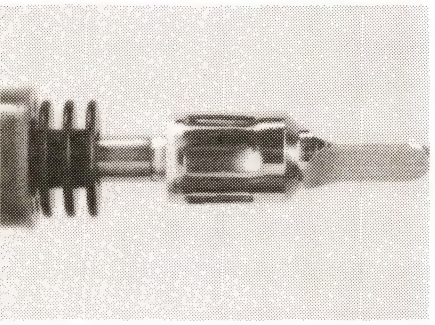
Figure 2. The 'zero-crossing' power control method employed to provide infinitely variable control of iron tip temperature without the spikes generated by other switch systems.

Flat tip PORTASOL portable butane powered soldering irons are widely used for repairing chipped skis and give excellent smooth finish.

Portable soldering power

HOT AND STRONG

The Portasol is a powerful soldering iron for both the professional and handyman. The tip temperature operates in excess of 400°C and is fully adjustable between 10 watts and 60 watts. It runs on standard household butane gas lighter fuel, and it takes only 10 seconds to refill. Each fill lasts an hour of soldering time.



PATENTED CATALYTIC CONVERTER

The tip contains a patented platinum catalytic converter that generates extremely high heat at the tip, **without a flame.** After igniting the butane with the built-in lighter in the protective cap, the Portasol takes just 20 seconds to reach operating temperature.

USE IT ANYWHERE

The real advantage of the Portasol is its size and portability. It's as small as a felt tip pen and easily fits into the pocket. The Portasol can be carried to the job, whether it's out of doors or out of reach of a power point, it makes no difference. Fixing a radio at sea, a car alarm, an outdoor telephone switch box, a toaster, or a model train, takes no time at all with the Portasol. No extension cords to plug in, no gas bottles to lug around, no nickel cadmium batteries to recharge. Just start the catalytic converter and begin soldering.

NO NEED TO WAIT FOR IT TO COOL DOWN

The on/off switch is automatically turned off if you put the cap back on while the Portasol is still operating. The cap is made from heat resistant nylon 6/6, and can be replaced after use without waiting for the Portasol to cool down. All you get is a warm pocket.

NO CURRENT LEAKAGE TO SENSITIVE CIRCUITS

The Portasol's butane energy source removes all risks of current leakage damage associated with normal mains irons.

A FEW TIPS FOR YOU...

There is a range of four easily replaceable screw-in tips available — 1.0mm, 2.4mm, 3.2mm and 4.8mm. The 2.4mm tip is standard fitting.

1.0mm 2.4mm 3.2mm 4.8mm

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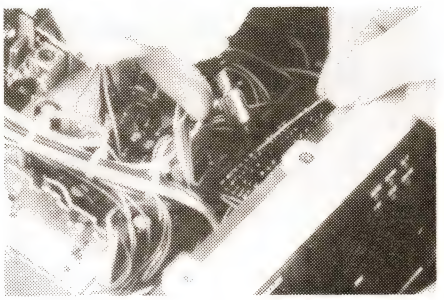

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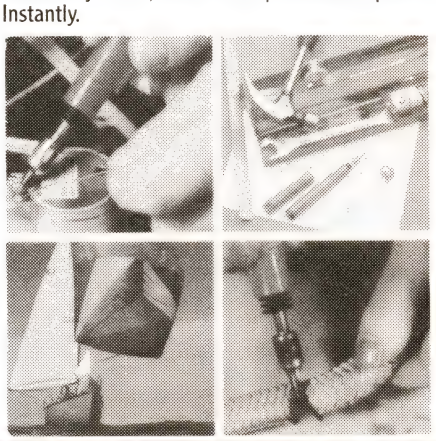
Outdoors or indoors. Fixing a plug or a printed circuit board. Rewiring a tractor or a model train. Working with leadlighting or splicing a rope. Repairing a hi-fi or a fridge. Whatever the need, wherever you are, the Portasol provides the power. Instantly.



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soldering time affect this problem. In some electrolytics, excessive soldering temperature and/or time can affect leakage current and noise levels.

Excessive temperature can affect the tolerance of some resistor types or cause damage to the terminations. The latter can be a problem where the termination is moulded into the resistor body assembly, resulting in poor contact with the resistive element that becomes noisy or intermittent with normal temperature cycling during operation.

Components which have glass-metal seals (thermistor "beads" and reed relays, for example), or epoxy-resin seals may be affected by excessive heat during soldering, resulting in a faulty part. In many ICs, the silicon chip inside the body is bonded to the substrate with a material that may be affected by excessive heat, resulting in a device which is faulty or may become faulty during later use.

The message here is that excessive soldering temperature may result in altered values or reduced service life for some components.

Hand tools

Broadly speaking, there are three "classes" of hand soldering tools: the constant heat or constant power type, the controlled power type and the temperature controlled type.

The *constant heat* or *constant power* type simply applies heat to the iron tip all the time. Temperature equilibrium is reached when the heat lost from the tip by dissipation balances the energy input. The idling temperature of the tip may be quite high indeed. In general, it is chosen to be below the temperature where oxidation of the iron tip's tinning occurs. The heating up time for such irons may take seven or eight minutes.

When a joint is made with any iron, the tip temperature will drop somewhat. Just how far depends on the iron's characteristics — the mass of the tip, the heat energy supplied, etc.

With a constant heat iron, the first couple of joints will likely be made at a temperature well above the ideal wetting temperature range. As the number of joints made without pause increases, the tip temperature gradually drops such that it may fall below the wetting temperature range necessary to make a good joint and "dry" joints result. Not the best recipe for reliability. Using irons such as this requires skill in recognising when joints are being made at too high or too low a temperature. In the latter case, pausing to allow time for the tip temperature to recover solves the problem. In the former case, timing of heating the joint parts is critical in order to avoid damage.

With controlled power irons, you have some manual control of the heat applied to the tip. In gas (butane) heated irons, ideal for use where power is not available and widely used in servicing, a gas flow control is provided. In electrically powered irons, a finger operated switch permits application of power to the tip as required. Such irons require some skill and experience to use. The problems of over- and under-temperature are clear.

Temperature controlled irons offer significant advantages, providing rapid warm-up, better heat transfer to the joint, maintenance of joint temperature during soldering, improved tip life and substantially reduced damage possibilities.

A variety of techniques are employed to control the tip temperature, each having their specific advantages and disadvantages.

One of the simplest involves using the property of a magnet that causes it to lose its magnetism when heated past a certain temperature — the "Curie Point". Figure 1 shows how such a scheme works.

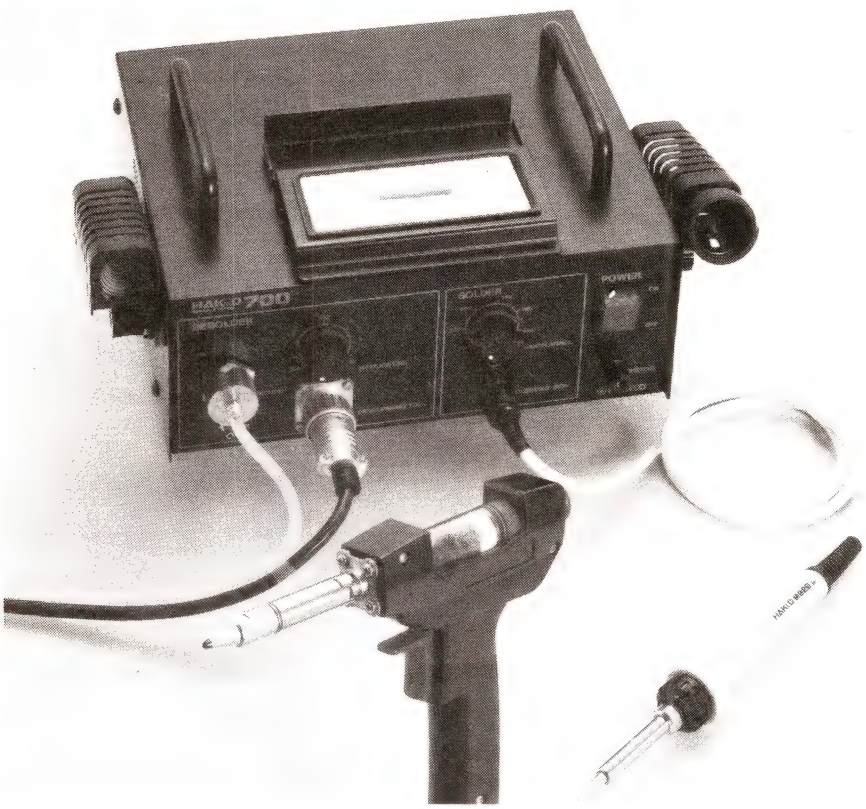
The permanent magnet is attracted to the cold tip which has a magnet of particular characteristics in its rear end, operating a switch in series with the element. The element heats the tip and, when it passes the magnet's Curie Point temperature, the switch turns off the power. When the tip temperature falls, the magnet is again drawn to the tip, turning on the power. There is some hysteresis and the tip temperature cycles over a small rand the tip temperature cycles over a small range. Replaceable tips with differing Curie Point sensing elements may be selected for different operating temperature ranges.

Closer control of the tip temperature can be gained with electronic control employing feedback of the tip temperature with some sort of temperature sensor. To avoid switching transients being coupled into the circuitry being soldered, "zero-crossing" power control is now widely employed to control the power to the heating element. The power is switched on and off for a given number of cycles, only turning on or off as the ac supply voltage passes through zero.

WHEN YOU HAVE NO POWER SOURCE

When you have no access to a power source and need to make soldered joints, you're in strife. The Portasol portable soldering iron, distributed by DRM Industries, solves the problem in a small butane gas heated iron featuring manual tip temperature control that allows you to operate the tip across the required wetting temperature range, providing equivalent power between 10 and 60 watts, and readily control the operation. Ideal for making low volume "field" repairs. It's the size of a felt-tip marker pen and runs on standard household butane. As it is not electrically heated, there is no danger of electrical leakage or electromagnetic induction affecting circuitry.

The Hakko 700 rework station station includes a soldering iron and a desoldering iron, both with temperature controlled tips featuring a variable control to set the optimimum tip temperature. Available from CLC Agencies (02)750 4005.



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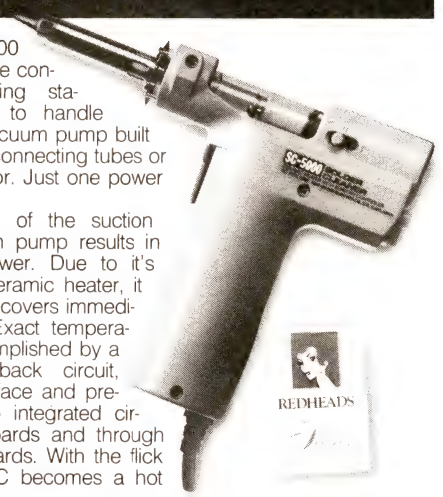

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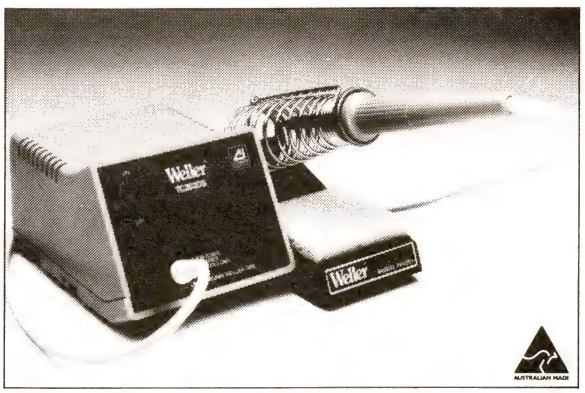

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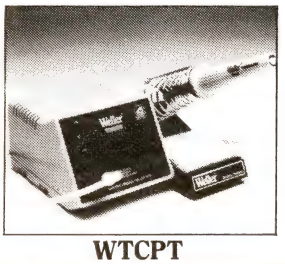

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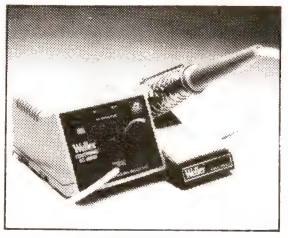

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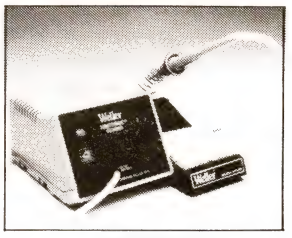

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Seven fundamental electronics facts

Part 2 – Ohm's law

Bryan Maher

Georg Ohm is probably the most well known and most often cursed figure in the history of electrical and electronics technology. Once you come to grips with Herr Ohm's law, and its subtle implications, you'll understand why!

BEING NOW well rested after last issue's little discussion about the first two of those seven basic experiments, with renewed verve and sharpened inquisitive mind we ask "Why do we believe Ohm's Law?" – and – "Is it really a Law?"

The third law

Georg ("gay-org") Simon Ohm (Germany, 1787-1854) wrote a paper in 1826 which stated in effect the following:

OHM'S LAW

"Under steady conditions, for any given circuit conductor carrying a steady current, the ratio of voltage drop across the conductor to current flowing through it is constant."

We call that constant the *resistance*, R, and can state the following relationship:

$V/I = R$ (the constant)

We honour Georg by giving the name "Ohms" and the Greek symbol *omega* – Ω – to the unit of resistance R. We accept this law easily now, but Georg Ohm had to fight for its recognition in 1826.

Voltage-current graphs

As Mr Ohm's Law relates a current to a voltage, why don't we graph it? Figure 1 does just that, showing the relation for identical-size samples of various metals, alloys, liquid metals and carbon – all measured at the same physical conditions, especially temperature.

On any graph the slope of the line indicates the relationship between the quantities. Here the slope represents the value of V/I, i.e: the slope tells us the value of the resistance R.

If it's true (as Mr Ohm said) that the relationship between the voltage and the current is constant, then the slope of that graph should be constant, i.e: the graph should be a straight line.

Slope indicates resistance. Let's look at what we've got in Figure 1. As long as all physical conditions remain constant, we *do* get straight line graphs for all pure metals. We notice that silver has the lowest slope, indicating that silver has the lowest resistance. Pure copper has the next lowest.

Alloys (metals with another element, usually a metal, dissolved in them) have a higher slope (i.e: higher resistance) than the pure metals.

Amongst the many readers of this excellent magazine someone (of enquiring mind) can be heard asking: "And why is there any resistance at all?" Well, the most modern ideas say that metallic conductivity is due to the movement of billions of electrons (negative charge carriers) within the metal. Electrons are so small and each carries such a tiny

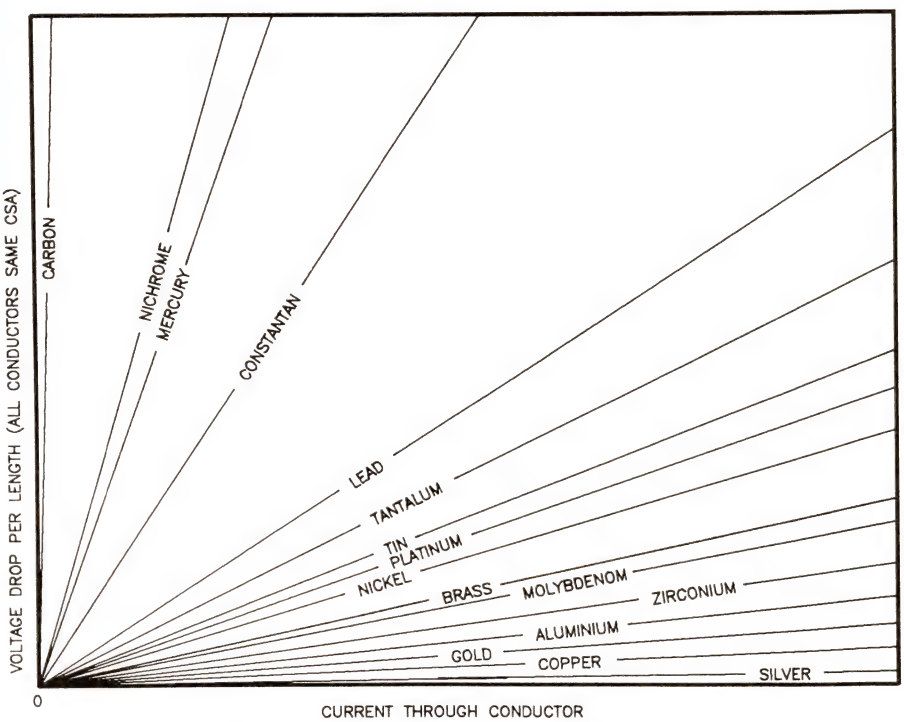


Figure 1. Graph of Ohm's Law for some conductors at constant physical conditions. Samples are the same size and resistance is determined by the slope of the graph.

quantity of energy that electrons and their movement is best described by Wave Mechanics.

Wave nature of electrons

Wave mechanics describes electrons by their wave nature, and the interference caused to the propagation of those waves. This description of electrons talks in terms of probability statistics taken over the billions of particles present.

Not wishing to become submerged in such theorising, especially at the weekend, we already know that most elements consist of some kind of crystalline lattice structure of atoms in a more or less definite geometrical pattern.

Many electrons belong to each atom (copper has 29 electrons per atom, gold has 79, etc.). In metals it is easy for one electron per atom to leave its atom and drift about within the crystal.

Positive atom "core". Having lost a negative electron, each remaining atom "core" is positively charged. The whole array of positively charged atom cores sets up a cyclic positive potential field as imagined in Figure 2a.

When we apply some voltage between the ends of the sample of metal, the wandering electrons are attracted to the positive end. As they do, the electron waves are scattered by this potential field causing reinforcing and/or cancellation of wave attributes.

Real, imperfect metals. However, Figure 2a imagines idealised conditions of a perfect geometric lattice pattern of atoms, all identical, all stationary. Unfortunately real life is not that good. In any *real* sample of metal there are always departures from the ideal geometric crystalline pattern, caused by a few atoms missing from their position – dislocations of the array as depicted in Figure 2b.

Even the boundaries of the lump of metal amount to interruptions in the pattern. Also, most lumps of metal are "polycrystalline", meaning composed of many separate small crystals squashed together.

As well, in real metals all atoms are not identical. There are always some impurities present, i.e: atoms of other elements, which have slightly different positive charge. We call all these crystal imperfections "lattice defects". ▷

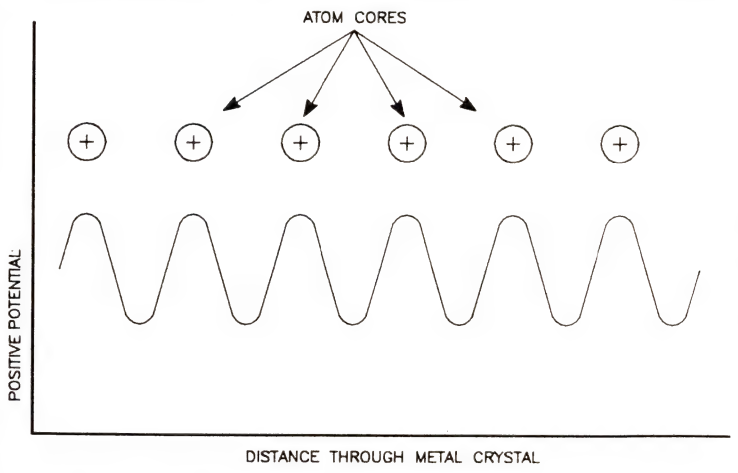


Figure 2(a). Electrons would travel without any losses if we had a cyclic positive potential due to perfectly crystalline metal.

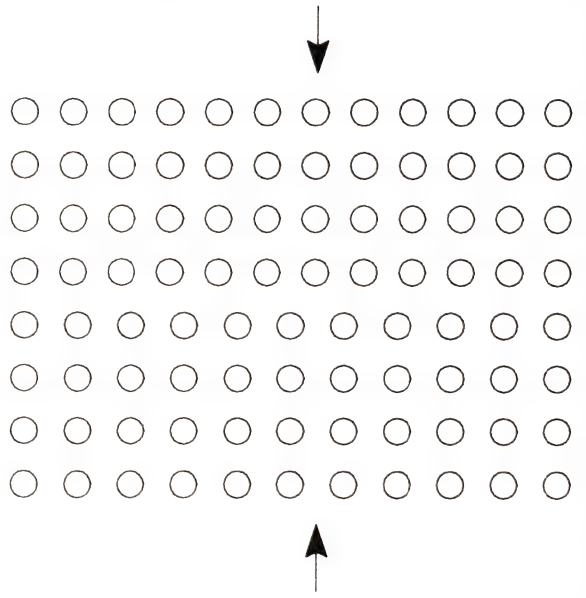
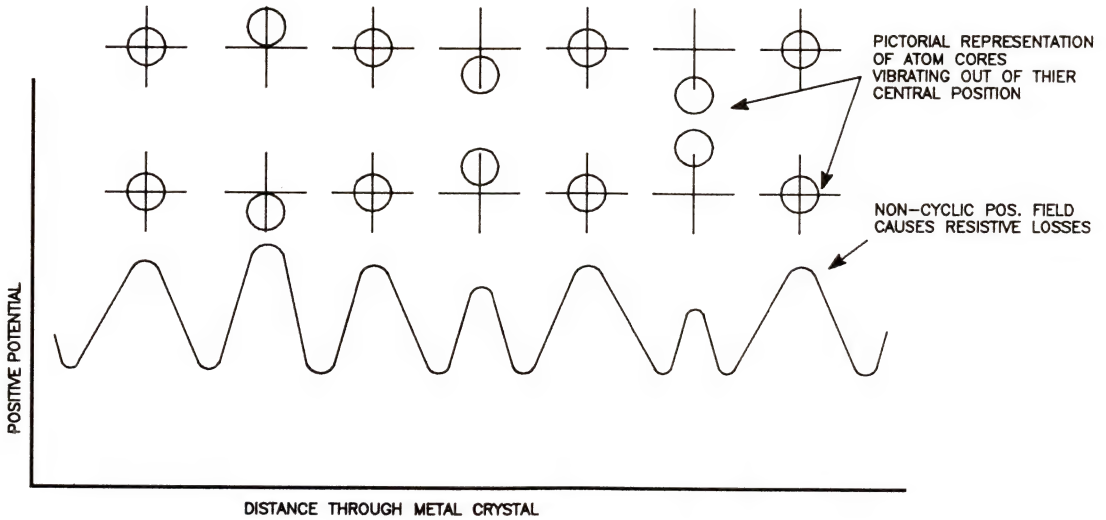


Figure 2(b). Example of a crystal dislocation which causes resistance by upsetting the perfect cyclic pattern. The "edge dislocation" is marked with arrows. Circles represent atom cores.

Figure 2(c). At room temperature the vibrational displacement of metallic atoms from their crystalline central positions is the predominant cause of resistance, as it upsets the cyclic positive potential field.


PICTORIAL REPRESENTATION OF ATOM CORES VIBRATING OUT OF THIER CENTRAL POSITION
NON-CYCLIC POS. FIELD CAUSES RESISTIVE LOSSES
POSITIVE POTENTIAL
DISTANCE THROUGH METAL CRYSTAL

Vibrating atoms. And if that's not enough, because of the temperature (even room temperature) of the piece of metal, all those atom cores are continually vibrating in three dimensions.

The effect of all these departures from the perfect crystalline geometric pattern of atom cores is that their positive potential field is not regular, as imagined in Figure 2c.

Perfect geometric structure. If the positive potential field were perfectly regular, that field would have no effect at all on the passage through the metal of the electron waves. There would be as much constructive interference as destructive interference.

But as we have shown, in real life because of the many lattice defects, there are irregularities in the positive potential field of the atom cores. Destructive interference exceeds constructive interference, hindering the passage of the electron wave, causing some energy to be given off as heat.

Cause of resistance

This conversion of energy to heat is attributed to a material characteristic we call "Resistance". It can be calculated that if the piece of metal had no boundaries, and if all those atomic "cores" would stand still, (they wont – but just imagine), and if the metal were perfectly pure (no impurities), with no lattice defects, then there would be no such thing as "Resistance" at all!

Every electric current would flow with no energy loss whatever! (This is analogous to light waves which would pass through a perfect dielectric crystal with no absorption at all.)

But none of those "ifs" will ever come true, (though the purity specification can now be approached quite closely), so at ordinary temperatures we will always have to put up with "Resistance" and the power loss it represents.

Modifications. Of the "Seven Basic Laws", Ohm's "Law" is one which we must modify for modern conditions. To be fair, we must admit that Georg Ohm lived in a world in which the range of conductors was much more limited than it is now.

However, Ohm's law is true for dc currents flowing in some components such as bulk metals, metal films, carbon, conductive ceramics and the latest conductive plastics, but *only when constant physical conditions prevail.* Such components we will call "Linear Components".

Linear components. For any given sample of conductor, the main "Constant Condition" required is constant temperature. But the resistance R is altered by any change in any physical condition. We list some of these, in roughly decreasing order of magnitude in Table 1. And on top of all that, many old-time and modern circuit components, not even dreamed of in Georg Ohm's day, e.g: semiconductor diodes, transistors, FETs and vacuum tubes, *do not obey Ohm's law at all.* These we call "Non-Linear Components", and will deal with them shortly.

What will affect resistance?

PHYSICAL CONDITIONS AFFECTING RESISTANCE

(In approximately decreasing order of importance.)

(1) Temperature.
(2) Frequency of the currents (if not dc).
(3) Mechanical tension.
(4) Mechanical pressure.
(5) Presence of magnetic fields.
(6) The history of the conductor, e.g: has it been bent, hit, pulled or otherwise interfered with?
(7) Direction of the current through the conductor.
(8) Voltage between the ends of the conductor.
(9) Mechanical acceleration of the conductor.

TABLE 1.

Temperature effects. For the linear components, of the nine physical conditions listed, *change in temperature* has by far the greatest effect on the resistance of most conductors. The fractional change in resistance as a function of change in temperature is called

"The temperature coefficient of resistance"

of that material or component. Call that small change in resistance "△ R" ([delta] R), where R is the value of resistance. Values of (△ R)/R per degree (in parts/million/degree) for some common conducting materials and commercially available resistors are given in Table 2.

Carbon – the strange element. The first part of Table 2 shows that carbon has a *negative* temperature coefficient – the resistance actually goes *down* as the temperature goes up!

This we explain by saying that carbon is a bit short on free "conduction" electrons. Oh, dont worry, carbon has plenty of electrons, but most of them are bound up to the atom cores; don't want to leave home, so to speak.

Increase in temperature gives some of these bound electrons enough energy to break away from the atom core and become free conduction electrons. More free electrons means less resistance.

Exactly the same effect occurs in pure intrinsic (undoped) semiconductor materials like silicon, germanium, gallium-arsenide, etc.

Temperature coefficient. While metal alloys have much higher resistivity than many pure metals, some alloys have less change in resistance with changing temperature, i.e: lower temperature coefficient.

From Table 2 we see that some metal alloys like manganin and constantan have extremely small temperature coefficients. These metal alloys are thus favorite choices for the manufacture of wire-wound resistors of high quality.

Naturally we would like resistors we purchase for our electronic circuits to have the same value of resistance at any temperature, i.e: we would like a zero temperature coefficient.

Manganin is about the best, constantan (also called Advance, Ideal, Eureka or Copel) is also pretty good. All

TEMPERATURE COEFFICIENT OF RESISTANCE

MATERIALS	TEMPERATURE COEFFICIENT (parts per million per degree)
Carbon	–500 ppm/degQ
Manganin	+20 ppm/deg
Constantan	+200 ppm/deg
Nickel-silver	+260 ppm/deg
Mercury liquid	+890 ppm/deg
Brass	+2000 ppm/deg
Copper	+3930 ppm/deg
Aluminium	+4000 ppm/deg
Lead	+4200 ppm/deg
Zirconium	+4400 ppm/deg
Tungsten	+4500 ppm/deg (electric lamp filament)
Cast Iron	+6000 ppm/deg
COMMERCIAL RESISTORS	
Oxide	–1800 ppm/deg (Dale type M51, 1 000 000 Meg)
Oxide	–1500 ppm/deg (Dale type F44TU, 150 000 Meg)
Carbon film	+500 ppm/deg (Dale type MC, 400k to 125M)
Metal film	+200 ppm/deg (Dale type A, 0.27 to 47 Ohms)
Metal film	+100 ppm/deg (Dale type CMF, 5 Ohms to 5M)
Metal film	+25 ppm/deg (Dale type CMF, 24.9 Ohms to 1.0 Meg)
Wirewound	+20 ppm/deg Dale type NH250, 500 Ohms to 37k, 250 W)

TABLE 2.

these alloys are therefore much better than any pure metal *for the making of resistors* for electronics.

Graph slope. Temperature coefficient of resistance for some materials is also indicated by the slope of the lines in Figure 3. The large upward slope for the pure metals indicates large positive coefficient.

Less slope means a smaller coefficient, while the slope for carbon is downwards, showing a negative coefficient, i.e: resistance falls as temperature rises.

For metals, Table 2 and Figure 3 only apply above some critical temperature, called the *Debye temperature*, which is related to the crystal structure of the element.

For gold, this Debye temperature is way down at –103°C, meaning that Table 2 and Figure 3 apply to gold at any temperature above –130°C.

For copper this Debye temperature is 42°C, and for iron 147°C. Thus Table 2 and Figure 3 for iron are not valid unless the temperature is a very hot 147°C or more.

Frequency. The second in our list of physical conditions, Table 1, says that if the currents are not dc, then current frequency affects the resistance of a conductor.

Yes – truly, we are talking about the real heat-producing resistance of a conductor (no, we are not confusing "reactance"). The explanation is that at high frequencies the ac magnetic field (set up by the current flowing in the conductor) pushes the moving electrons out from the middle of the conductor, forcing all those conduction electrons to flow near the surface.

This is called the *"Skin Effect"* and at high enough frequencies there are no conduction electrons anywhere near the centre. With only part of the cross-sectional area being used, this has the same effect as if only some of the metal existed, resulting in higher effective resistance.

Because the centre of a conductor is never used at high frequencies, you might as well use copper tubing for high frequency conductors. This is actually done, sometimes even silver plated copper tubing.

After all, if all the current wants to flow almost on the surface of the conductor, might as well give it a silver pathway for lowest achievable resistance under the circumstances.

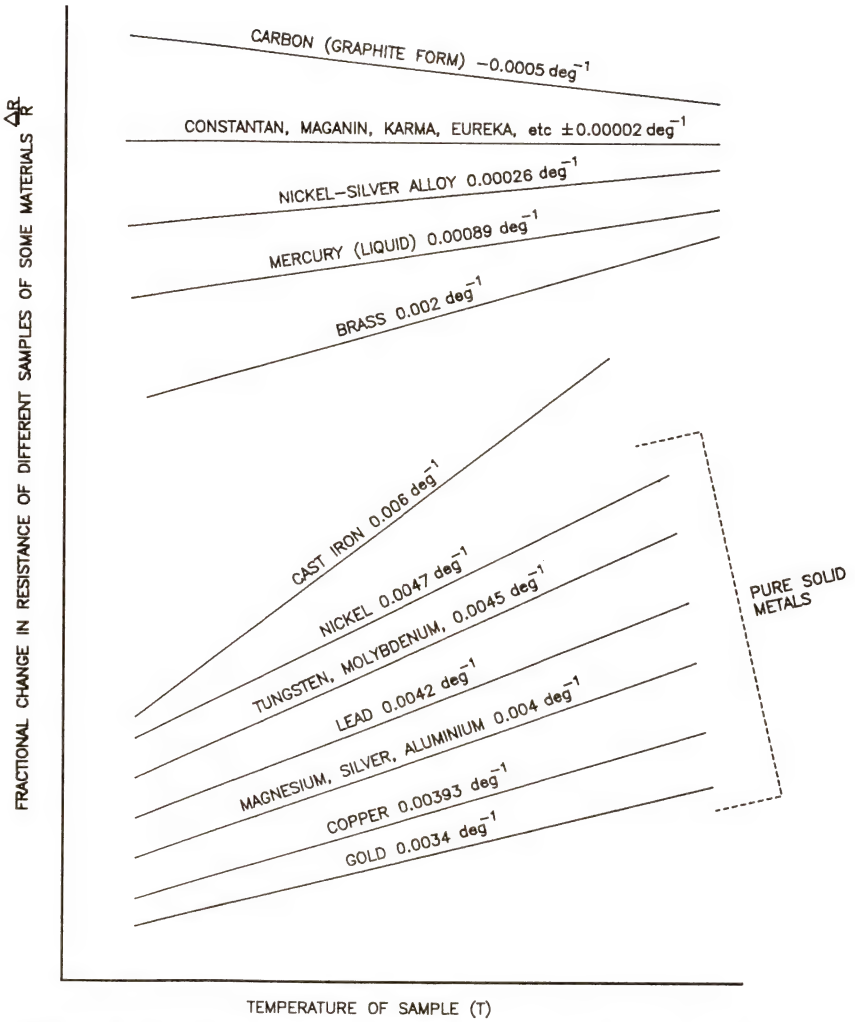

FRACTIONAL CHANGE IN RESISTANCE OF DIFFERENT SAMPLES OF SOME MATERIALS $\frac{\Delta R}{R}$
CARBON (GRAPHITE FORM) −0.0005 deg^{-1}
CONSTANTAN, MAGANIN, KARMA, EUREKA, etc ±0.00002 deg^{-1}
NICKEL–SILVER ALLOY 0.00026 deg^{-1}
MERCURY (LIQUID) 0.00089 deg^{-1}
BRASS 0.002 deg^{-1}
CAST IRON 0.006 deg^{-1}
NICKEL 0.0047 deg^{-1}
TUNGSTEN, MOLYBDENUM, 0.0045 deg^{-1}
LEAD 0.0042 deg^{-1}
MAGNESIUM, SILVER, ALUMINIUM 0.004 deg^{-1}
COPPER 0.00393 deg^{-1}
GOLD 0.0034 deg^{-1}
PURE SOLID METALS
TEMPERATURE OF SAMPLE (T)

Figure 3. The temperature coefficient of resistance (the change in resistance per unit resistance) changes with temperature, indicated by the slope of the lines.

Mechanical tension. The third physical property affecting resistance is mechanical tension in the conductor. Such tension physically stretches the conductor – making it longer, reducing its cross-section, and so increasing its resistance.

This effect can be used in a bridge circuit to measure mechanical tension, by measuring the change in voltage drop across the stretched conductor. Some "Statham" fluid pressure transducers work by this principle.

Mechanical pressure. The fourth physical property is mechanical pressure. It has been experimentally determined that for most metals resistance *decreases* when mechanical pressure is applied to the conductor.

We say "most metals" as the effect does not occur in some metals, namely lithium, calcium, strontium and bismuth.

Magnetic fields. Magnetic fields have some effect on the apparent resistance of a conductor by deflecting the electrons out of their preferred path. The magnetic fields exert a force upon the electrons at right angles to their direction of motion.

Conductor history. The resistance of some conductors, e.g: copper, is brought down to its true value by proper annealing (heat treatment), which allows the crystalline distribution of atoms to take up their closest approach to the ideal. In copper, this procedure reduces the electrical resistance, and also softens the metal.

Any subsequent mechanical movement of the copper, such as bending, pulling, hitting, bashing etc (work hardening), will disorder the array of atoms, and as we have previously seen, this increases the resistance. From then on, the resistance will be slightly higher than the minimum value achieved by annealling.

Current direction. If a conductor can be prepared in single crystal form, (i.e: not the usual polycrystalline conglomerate) the resistivity of the sample as measured between opposite faces of the crystal may depend on which ▷

WHAT IS A METAL?

As Table 2 shows, all pure metals have about the same temperature coefficient, about +4000 ppm/deg. Indeed, your humble author has always used this fact as a definition of the word "metal". If that puzzles you, gentle reader, try making up a better definition of the word "metal" . . .

Our schoolday definition of a metal as something "shiny and hard" could also apply to red apples or your teeth! Or the dictionary description as "opaque but a good conductor" also applies to carbon or conducting ceramics.

crystal axis is being followed.

This effect is called *anisotropic conduction* and shows up in some materials, e.g: single crystal gallium. In some materials, resistivity can be as much as twice as high in one crystal direction as another.

Voltage dependency. The electric field applied between the ends of a conductor, as well as attracting the free conduction electrons (causing current flow) also has attraction/repulsion effects upon the "fixed" atom cores. This effects a slight change in the value of the resistance of the conductor.

In commercial resistors, e.g: Dale, type P metal film 2.0 megohm (2MΩ) models, this "voltage coefficient" is given as *"Not more than 5 Ohms per million Ohms per volt applied." Thus a 2MΩ* resistor may change as much as 10 Ohms for each volt applied. Other type resistors have different values of voltage coefficient.

Mechanical acceleration. It is difficult to show that mechanical acceleration of a conductor affects the value of current flowing through it, equivalent to a change in the conductor's resistance. But such effects have been demonstrated.

In one experiment, a closed ring of conductor (with no potential source at all) was spun at high rotational speed, then suddenly brought to a stop. During the severe deceleration, a current flow was detected in the closed wire ring even though no voltage source was involved. This current was attributed to the electrons within the conductor moving through it (due to their momentum) during the deceleration period.

It is postulated that if a working electronic circuit, complete with voltage sources, were to be violently accelerated (or deceleration), the electron's momentum would modify the values of currents already flowing in the conductors, equivalent to a change in the conductors' resistance. Fascinating!

Perhaps this effect might become important in the future when electronic equipment is subject to tremendous acceleration in rocket or other such propulsion.

Non-linear components

In every one of the non-linear components and non-linear materials, ***Ohm's Law is NOT obeyed.*** Here we mean that the ratio of voltage-to-current is most definitely *not* a constant. The graph of voltage as a function of current is not a straight line, as Figure 4 shows for the case of a semiconductor diode.

Furthermore, the Law according to Georg Ohm implies that the conductor has no sense of direction of current, i.e: the component and the equation are bilateral. He said the results would be the same if the component were turned around end-for-end in the circuit.

A bilateral component has *"end-for-end-ability"*. True it is that all the materials we usually call "conductors", e.g: silver, copper, gold, aluminium, brass, carbon, iron, nickel, etc are bilateral. This also applies to metallic switches, filament lamps, resistors for power or electronic circuit use, electric heating elements, even dc motors of the shunt, compound or series field types.

Bilaterality here means that it makes no difference which way we pass the current through the component or appliance. Results are the same either way. However, many (but not all) of the non-linear components are definitely *not* bilateral.

Notice I said "components", not "materials", for most of the non-linear items we deal with are manufactured circuit components, not just materials.

Diodes. Probably every reader knows that semiconductor diodes rectify electric currents, meaning that these diodes pass current more easily in one direction than the other. In so doing, diodes very conveniently rectify the ac mains to dc for us, and can also be used to demodulate radio and television signals.

But diodes can do a lot more for us. In rectifying, they show their non-bilaterality, they are certainly not "end-for-end-able".

But even within a single polarity of conduction, diodes of all types *do not obey Ohm's Law.* Their ratio of voltage-to-current is not a constant, and the graph of this relation is not a straight line, as Figure 4 shows. Remember from Figure 1 that a steep slope means a high value of resistance, and an almost flat slope corresponds to a low value of resistance.

Diode "resistance". We can speak in the same terms about semiconductor diodes, where Figure 4 shows that in the forward current mode the diode characteristic curve has very small, almost flat, nearly zero slope. This gives the effect of very low resistance in the *forward* direction.

But in the reverse current mode the curve is nearly vertical, a large value of slope for the curve. This gives the effect of very high resistance. At no point is the curve straight – the relation never obeys Ohm's Law.

If you don't recognise the shape of the curve, just turn the page around (anticlockwise) and then hold it up to a mirror, where you will see the more familiar exponential curve of diode current as a function of diode voltage. The exponential function is the *inverse* (mirror image) of the logarithm function.

Transistors. Because junction transistors are fabricated using the same junction techniques used to manufacture semiconductor diodes, all transistors are also highly non-linear, and do not obey Ohm's Law.

Grandpapa would tell you that very much the same effects occurred in the vacuum tube (valve) diodes he used long ago, but the mathematical relationships were a bit different.

Vacuum tube diodes certainly rectified RF and mains power alternating current. That's how they got to be called "valves" in most English-speaking countries by analogy to the non-return water valves used in pumps. But the

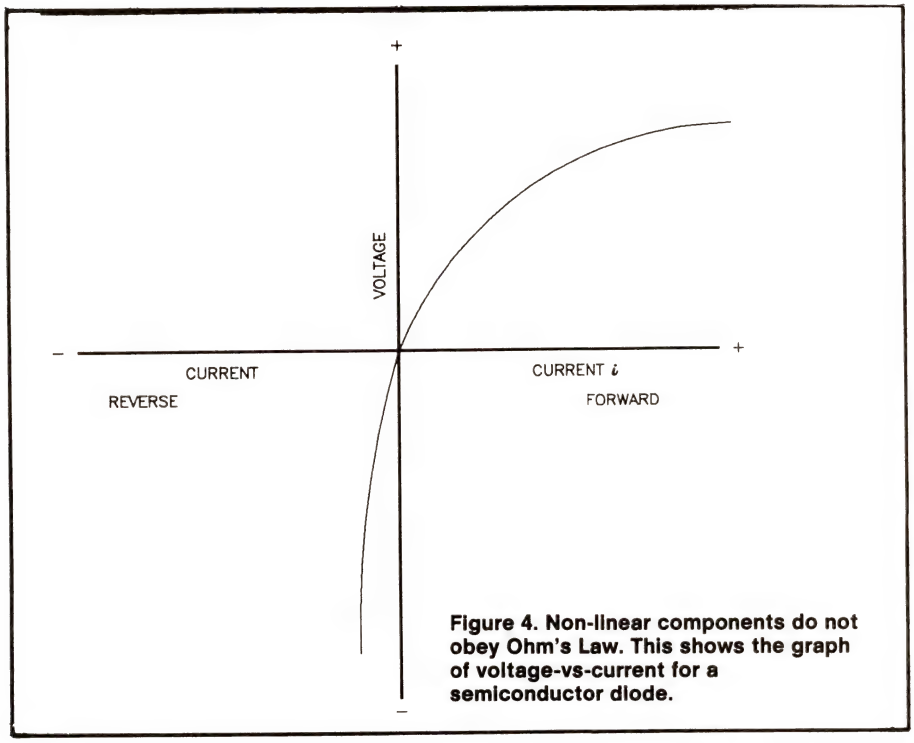


Figure 4. Non-linear components do not obey Ohm's Law. This shows the graph of voltage-vs-current for a semiconductor diode.

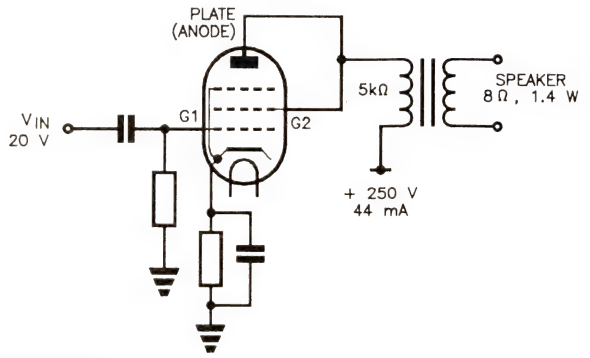


Figure 5. Valves never learned Ohm's Law!

Americans stuck to the name "vacuum tubes".

Vacuum tubes/valves. No vacuum tubes ever obeyed Ohm's Law! Their voltage/current relationship is never linear, their graphs are not straight lines. The art of using vacuum tubes involved trying to work the valve on a restricted part of the voltage/current graph where the curvature was not too bad.

The vacuum tube era brought forth some strange defiances of Ohm's Law. Figure 5 shows a beam power pentode, a five element high power output tube, in this case a 6L6GC. The tube is triode connected to reduce harmonic distortion. Triode connection means grid G2 is tied to the plate, effectively making it a three element device.

Remember that the electron stream from cathode to plate is very much an electric current. Most of this electron current flows from the cathode, right through the screen grid, G2, to land on the plate. That is, in the region between screen grid and plate, considerable current is flowing.

Current without voltage. Now wait just a cotton-picking minute, sir! Why should a current want to flow in the space between screen grid and plate when the circuit in Figure 5 *clearly* shows that there is definitely no voltage at all across that space! Anyone can see that screen grid and plate are joined – they are both at the same potential!

Look – no volts! Yes indeed – here we have a case of current flowing in a region even though there is no voltage drop across that region. That absolutely *defies* Ohm's Law, doesn't it?

You can't have a voltage/current relationship when you have a current but no voltage drop at all! Puzzle on that one awhile.

The TV picture tube. Now for a change of scenery. Let us look at a TV picture tube. (So what's new, you were looking at TV while you were reading this, perhaps?)

No, I mean let's look into the *electrical operation* of that tube. The tube has a hot cathode at the back, (right down at the tail end) emitting copious quantities of electrons. This cathode is kept close to ground potential.

At the front of the tube an anode is formed by conductive coatings (aquadag) inside the glass sides, plus a very thin layer of aluminium just behind the screen phosphor layers. The anode is kept at a high positive potential, perhaps 16 to 20 thousand volts.

Electron stream. Electrons emitted by the cathode are attracted by the high positive potential on the anode. This flow of electrons constitutes current flow. (Other elements within the tube perform electron control and focussing functions and magnetic fields produce beam deflection)

Our question is – does this current flow obey Ohm's Law? The short answer is that it does not! But why not? Take an average length picture tube, using 20 kV accelerating potential on the anode. The electrons are accelerating all the way from cathode to anode, reaching a final velocity just before landing on the anode.

Relativistic? Relativity theory says that the electron mass a increases with velocity. Calculations show that:

Final electron velocity = 0.27 C (approx)

where C = velocity of light,

so final electron velocity = 82 000 km/sec (approx)

Final electron mass m = (electron rest mass) x 1.04

Near-constant mass and acceleration. Because this final electron mass is only 4% higher than the electron's mass at rest, we may use Newton's classical acceleration formulae without too much error. This also means that the acceleration will be almost a constant, i.e: uniform acceleration throughout the tube. You remember these formulae of uniform acceleration from school, of course. They are:

$F = ma$
$v = u + at$
$s = ut + 1/2at^2$
$v^2 = u2 + 2as$

where

F = force
m = mass
a = acceleration
v = velocity
u = initial velocity
t = time of acceleration
s = distance travelled

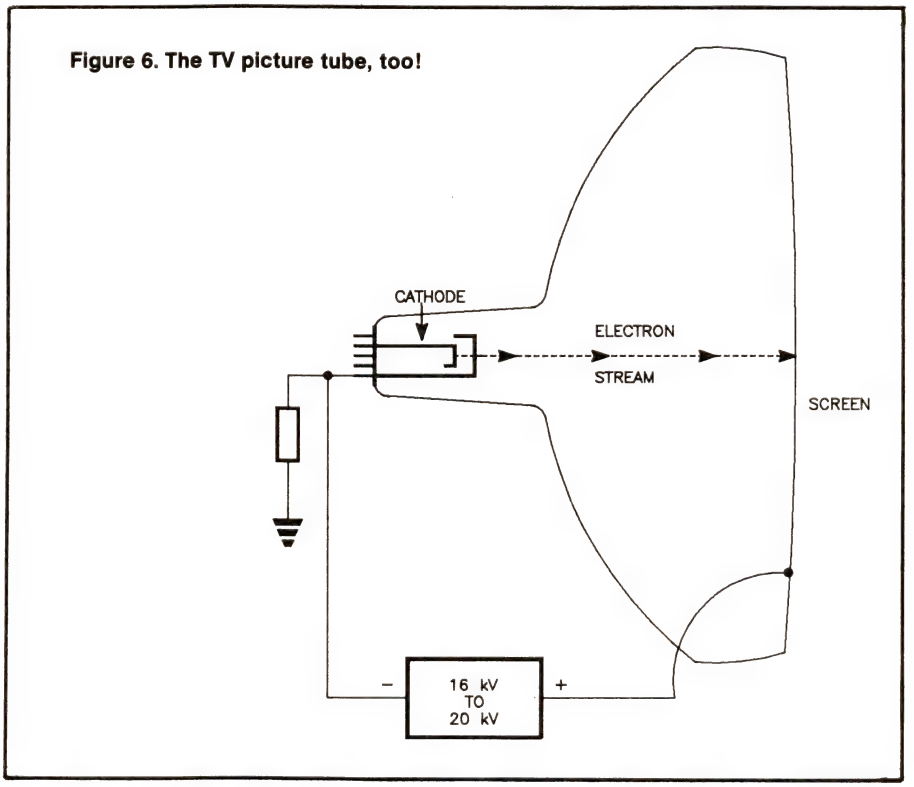


Figure 6. The TV picture tube, too!

Applying the third equation above,

$s = ut + 1/2at^2$

But, as initial velocity (electrons leaving the cathode) is insignificantly small, we can use

$s = 1/2at^2$, or

$1/t^2 = a/2s$

Also the distance s, the length of the tube, is a constant, so $1/t^2$ is proportional to a, (which is equal to F/m), so $1/t^2$ is proportional to F/m.

Nearly constant mass. But electron mass m is near enough a constant (it only increases by 4%), so $1/t^2$ is proportional to F.

But the force F (which is accelerating the electrons) is proportional to the tube accelerating voltage, V, often about 20 kV. So $1/t^2$ is proportional to voltage.

Current? Now, for any one setting of the TV brightness and contrast controls, there is some fixed number of electrons in the electron stream. This fixed number is independent of the accelerating voltage V. Call this fixed number "N", i.e: we have N electrons in the stream. These N electrons carry one electron charge each, a fixed total of N electron charges.

Furthermore if (N charges) is some fixed number, then (N^2 charges) is also some (different) constant number. So (N^2 electron charges)($1/t^2$) is proportional to voltage (because multiplying by any constant still leaves it proportional). Thus, ((N charges)/t)^2 is proportional to voltage (we just rearranged it).

Yes, current squared! But (N charges/t) means some number of charges passing per second, and that is exactly the definition of electric current!

So, (electric current)^2 is proportional to voltage or proportional to $\sqrt{}$voltage!

Wow! So in your friendly TV picture tube, the electron beam current is *proportional to the square root of the voltage* which caused it, (not proportional to voltage).

Definitely *not* according to Ohm's Law.

Enough! Let's attempt no more proofs, for there are stacks of components and places in electronics and electrical engineering where Georg Ohm's Law does not apply. Let's list some.

Non-Ohmic devices

(1) *Gas Thyratron tubes;* where current is nearly independent of voltage.

(2) *Ignitron tubes.*

(3) *Vacuum tubes;* like the EN31, 884 and 83V.

(4) *Steel tank mercury arc rectifiers,* where voltage drop is nearly constant at any current.

(5) *Mercury vapour rectifiers.*

(6) *Plasma* (i.e: extremely hot gas). As most of the universe is in the plasma state (the sun and all the stars) could we say that most of the universe does not obey Ohm's Law? (Your author might get the sack for that statement – but is it not true?)

(7) Common *fluorescent tubes.* Their resistance decreases as current increases.

(8) *Electrolytic liquids* in tanks. Here resistance increases as current increases.

(9) *Thyristors.*

(10) *Lightning arresters.*

(11) *Tunnel diodes;* whose resistance changes violently (even going negative) at different current values.

(12) *Constant current "diodes".*

(13) *X-Ray tubes.*

(14) *Series dc generators;* (as voltage boosters placed in series with some other dc generator and its load for auto voltage regulation).

(15) *Negative resistance* circuits.

(16) *Very thin oxide layers;* less than 10 nanometers thick, such as copper oxide or aluminium oxide. These are the common surface layers we always find on copper or aluminium conductors the moment they are exposed to air. These oxides are nominal insulators, but conduct well by electron tunnelling action. Conduction through these layers does not obey Ohm's Law.

And there are probably more!

For the rest –

For the rest, Georg Ohm's Law is obeyed, a statement we believe because of a mass of experimental evidence.

Results of masses of experiments done in various parts of the world over many years by different people all confirm that Ohm's Law is obeyed by all the *linear* materials, components and devices. *That is the only reason we believe in his Law.*

Next month we will amuse ourselves by looking into two more of these fundamental "Laws", where voltage is not proportional to current, and vice versa.

▷ from page 41.

high the thermal stresses are not enough to bring about complete decohesion, as would normally be expected when spalling occurs. A further factor in the corrosion process is the deposition of coal fines which can absorb chloride compounds and worsen corrosion attack in the long run.

A great deal of study has yet to be done on the erosion and corrosion, but progress made so far has provided the information needed to advise design engineers about choice of materials, acceptable operating conditions and likely endurances that can be expected for heat exchanger components in combustors and gasifiers. Coal conversion pilot plant, such as the pfbc plant at Grimethorpe in the UK and at other places in Europe will produce data in more realistic conditions.

A critical feature of combined cycle operations based on coal gasification is the performance of the gas turbine. The high entry temperatures that are needed to obtain maximum efficiency are a severe challenge to turbine materials. Advanced technology in blade cooling will be necessary and levels of chloride and sulphate compounds will have to be low to reduce corrosion problems.

Although no large combined-cycle power plants using pfbc or gasification are yet operating in the UK, the situation could change markedly in the next few years if demonstration plants now in operation, or being built in other parts of the world, can be shown to operate efficiently and with availability factors comparable to those obtained with conventional plant. It is generally acknowledged that suitable materials can be found to resist corrosive and erosive attack, but that operating conditions may be somewhat restricted to make sure that new plants are reliable. Any decision on the optimum system for clean power generation must take account of the fine balance between *efficiency* on the one hand and *reliability* on the other. Materials hold the key.

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Solderless Breadboards

You're far more likely to get that brilliant new design to work if you breadboard it and Geoff has a great range of breadboards for you to choose from. So toss out all those rat's nests and do the job properly!

Tie Points	*Term'l Strips*	*Distrib Strips*	*Bind'g Posts*	*Model*	*Price*
840	1	2	-	B112A	**$18.00**
2420	3	5	4	B135	**$50.70**
3620	4	7	4	B147	**$69.95**
	Comp Strips	*Distribution Strips*			
540	1	2		B212P	**$22.85**
3160	4	8			
	plus UC-02 edge plate			UIB46	**$92.50**
2320	3	4			
	plus UC-02 edge plate			UIB34	**$126.50**

UC-Series Universal I/O Strips

These strips simplify interfacing between breadboards and external circuits by providing breadboard connections to connectors

Connector Type	Model	Price
2x32way Card Edge 0.156" pitch	UC01	**$19.05**
25way D Sub Male & Female	UC02	**$19.50**
60 way straight header	UC03	**$27.55**
2x28way Card Edge 0.396mm pitch	UC04	**$28.50**
32way DIN41612 - 5.08mm	UC05-3	**$20.65**
64way DIN41612 - 2.54mm	UC05-6	**$25.90**
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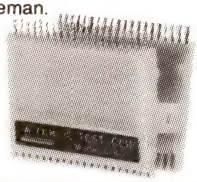

PROM Programmer for your IBM PC

Plug-in unit for PC/XT/AT machines. Programs EPROMs 2716A to 27512A NMOS and CMOS types and EEPROMs 2804 to 58064. Over 26 commands to read, write, verify, modify data, check sums and erase. On screen HELP provided plus device pin-outs. Has four zero insertion force sockets. Excellent value at **$309.95.**

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LF-4 10Amp(cont) rated fitted with 4 individually filtered outlets and circuit breaker **$269.00** (**$230.60** ex tax)

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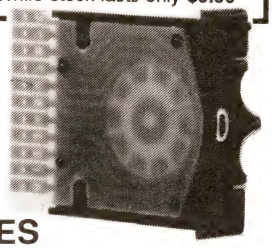
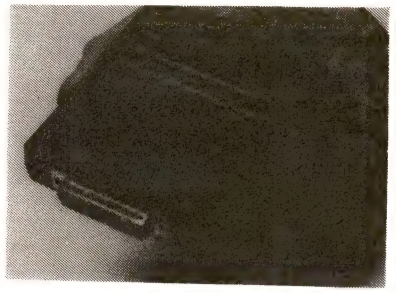
64kx1 ceramic pack 150nS Fujitsu MB8264A-150 While stock lasts only **$5.50**



THUMB-WHEEL SWITCHES

These are genuine C&K high quality. Available in decimal or BCD format. PCB edge connector or solder leads on directly. Both types are **$6.85** each. End plates are **$3.80** a pair and screws are **$1.40** a pair. They come in sizes depending on number of wafers 1- 3 or 3 to 7. Please specify when ordering.

"COMTEST" RS232/V24 TROUBLESHOOTER



Europe's most popular high quality RS232 tester will save time and trouble because it checks **ALL** the lines on any RS232 communications equipment.

- *Tristate monitoring of all 23 signal lines*
- *Breaks and redirects all 25 lines*
- *Ground voltage differential testing between DCE-DTE*
- *Four level bi-directional current loop test*
- *Simple operation - no batteries required*

Comtest has 25 DIL switches with DTE and DCE interface pins on both sides. Break and patch all 25 lines with switches and jumpers provided. Instructions clearly printed on both sides (and won't wear off) with abbreviation guide to aid identification of connections. All contacts are gold plated. Comes in transport pouch with 8 jumpers. Don't confuse this quality unit with the cheap immitations around. This one is designed in Sweden and compares favourably with testers over $500. Well worth **$315.00**

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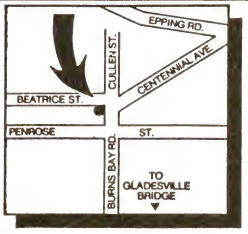

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This unique device allows you to test whether or not a particular device or conductor is live, WITHOUT dismantling the device or stripping any wires. The Combi-Sensor is so sensitive it will detect voltages as low as 20 Volts.

It does this by detecting the associated field that is apparent when a voltage is applied to a conductor. The Combi-Sensor is as simple to use as your household torch, just place the end of the device near the object under scrutiny and press and hold the button on the top of the sensor. If a voltage, be it ac or dc, is present the Combi-Sensor will beep and an indicator LED will light.
What could be more simple?

A great buy at $34.95!

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Not only can you check whether or not a power point is live, the Tester Plus is a ONE-PROBE continuity tester. To check, say, the continuity of a length of wire, all that is required is to hold the Tester Plus screwdriver with your thumb in contact with the metal plate on the side, touch one end of the wire with the tester's probe and the other end with your remaining hand. So easy even Uncle Fester can use it!

The Tester Plus has hundreds upon thousands of applications for the serviceman, enthusiast and professional alike. Battery and semiconductor testing, continuity check, voltage testing, automotive uses, repairing the boat – the list goes on!

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(PAT. PENDING)

MAIN FEATURES

- Solid state reliability
- Safe in use
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- No test leads
- Handy and useful.

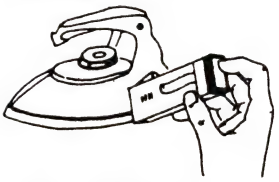
$34.95

Combi-Sensor is equipped with a test light and a sound emitting buzzer, and is operated by two standard AA batteries.

SOME OF THE SUGGESTED APPLICATIONS

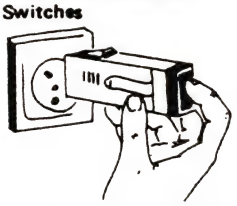
A – Detecting Live Conductors (Voltage Presence Test)
Press your Combi-Sensor slightly to the insulation of the tested conductor and push the button. If the tested conductor is live, Combi-Sensor will indicate it clearly by glowing test light and by continuous buzzing.

B – Testing Connection to Ground



The tested electrical appliance should be switched on. Press your Combi-Sensor slightly to the appliance's surface and push the button. If the tested appliance is not grounded, Combi-Sensor will indicate it immediately by glowing test light and by continuous buzzer.

C – Wall Outlets and Switches



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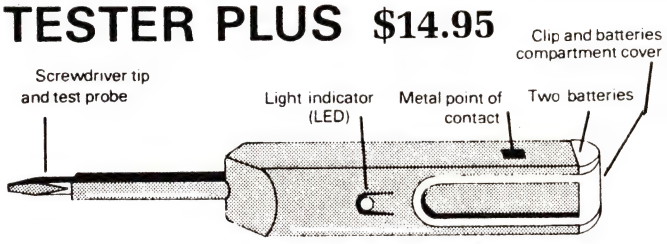
TESTER PLUS $14.95



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. . . . . Combi-Sensor(s) at $34.95 each.

. . . . . Tester Plus(s) at $14.95 each.

plus post and handling $3.00. per order.

I am paying by:

☐ Cheque ☐ Money Order ☐ B/Card ☐ M/Card ☐ Visa

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Centre Frequency (kHz): 40 + −1.0
Sound Pressure Level 10V RMS: 110dB min.
Sensitivity (dB/v/ubar) min.: −65 min.
Bandwidth (kHz):
Transmit: 4.0 (at 100dB)
Receiver: 5.0 (at −73dB)
Impedance:
Transmit: 500
Receiver: 5000

Cat. L19990 (Transmitter) **$6.95**
Cat. L19991 (Receiver) **$6.95**

ELECTRET MIC INSERTS

With pins for easy board insertion.
Cat. C10170

1-9	10+	100+
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Cat. H28600 ..... **$29.95***
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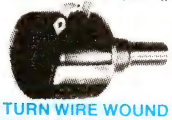

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Spectrol Model 534
¼" shaft.
Equiv (Bourns 3540S, Beckman 7256)
Dials to suit 16-1-11, 18-1-11, 21-1-11.

R14050	50R	R14100	5K
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1-9	10+
$9.95	**$9.50**

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Unencoded keypad, 10 digit keys plus two utility keys. Light grey in colour
OUTPUT ARRANGEMENT:

Output Pin N°:	Symbol
1	N.A.
2	Shield plate
3	Column 2
4	Row 4
5	Column 3
6	Row 1
7	Column 1
8	Row 2
9	Row 3
10	N.A.

Cat.C19030

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$2.95	**$2.50**	**$1.95**

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Q10525	MU45 0-20V	12.50
Q10530	MU52E 0-1A	14.50
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Leakproof, long service life batteries ideal for security systems, emergency lighting or as a computer backup power supply, etc.

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9mm hole, available 3 colours

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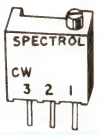

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Cat.No.	Description	1-9	10+
R14700	10R	**$3.50**	**$3.20**
R14710	20R	**$3.50**	**$3.20**
R14720	50R	**$3.50**	**$3.20**
R14730	100R	**$3.50**	**$3.20**
R14740	200R	**$3.50**	**$3.20**
R14750	500R	**$3.50**	**$3.20**
R14760	1K	**$3.50**	**$3.20**
R14770	2K	**$3.50**	**$3.20**
R14780	5K	**$3.50**	**$3.20**
R14790	10K	**$3.50**	**$3.20**
R14800	20K	**$3.50**	**$3.20**
R14810	50K	**$3.50**	**$3.20**
R14820	100K	**$3.50**	**$3.20**
R14830	200K	**$3.50**	**$3.20**
R14840	500K	**$3.50**	**$3.20**
R14850	1M	**$3.50**	**$3.20**

CENTRONICS SOLDER PLUGS SPECIALS!

1-9	10+	100+
$2.95	**$2.50**	**$1.95**

DB25 CONNECTOR SPECIALS!

TYPE	1-9	10+	100+
9P	$0.70	$0.60	$0.50
9S	$0.70	$0.60	$0.50
9C	$0.60	$0.50	$0.40
15P	$0.70	$0.65	$0.60
15S	$0.70	$0.65	$0.60
15C	$0.70	$0.60	$0.50
25P	$0.70	$0.60	$0.50
25S	$0.75	$0.65	$0.60
25C	$0.70	$0.60	$0.50

DB 25 CRIMP SPECIALS!

Type	1-9	10+	100+
Female	$2.95	$2.50	$1.95
Male....	$2.95	$2.50	$1.95

TAG TANTALUM CAPACITORS SPECIALS!

Cat.No.	Description	Price
R16124	16V 4.7uF	$0.48
R16125	16V 10uF	$0.52
R16126	16V 15uF	$0.75
R16128	16V 22uF	$0.85
R16216	25V 2.2uF ..	$0.40
R16220	25V 4.7uF ..	$0.70
R16222	25V 6.8uF ..	$0.70
R16224	25V 10uF	$0.60
R16228	25V 22uF	$2.40
R16300	35V 0.1uF ..	$0.30
R16302	35V 0.15uF..	$0.30
R16304	35V 0.22uF..	$0.30
R16306	35V 0.33uF..	$0.30
R16308	35V 0.47uF..	$0.30
R16310	35V 0.68uF..	$0.35
R16311	35V 0.82uF..	$0.35
R16312	35V 1.0uF ..	$0.30
R16314	35V 1.5uF ..	$0.50
R16316	35V 2.2uF ..	$0.50
R16318	35V 3.3uF ..	$0.35
R16320	35V 4.7uF ..	$0.70
R16322	35V 6.8uF ..	$0.80
R16324	35V 10uF	$0.80
R16326	35V 15uF	$1.40
R16328	35V 22uF	$3.50

QUALITY 3mm LEDS

Cat. No. Col.	1-9	10+	100+
Z10140 Red	**$0.15**	**$0.12**	**$0.10**
Z10141 Grn	**$0.20**	**$0.15**	**$0.12**
Z10143 Ylw	**$0.20**	**$0.15**	**$0.12**
Z10145 Ora	**$0.20**	**$0.15**	**$0.12**

QUALITY 5mm LEDS

Cat. No. Col.	1-9	10+	100+
Z10150 Red	**$0.08**	**$0.07**	**$0.06**
Z10151 Grn	**$0.15**	**$0.12**	**$0.10**
Z10152 Ylw	**$0.15**	**$0.12**	**$0.10**

NICADS!

Save a fortune on expensive throw away batteries with these quality Nicads and Rechargers!

Size	Desc.	1-9	10+	100+
AA	450 mA.H.	**$2.95**	**$2.75**	**$2.50**
C	1.2 A.H.	**$9.95**	**$9.50**	**$8.95**
D	1.2 A.H.	**$9.95**	**$9.50**	**$8.95**

RELAYS

1-9	10+	100+
S.P.D.T. 3A connectors.....	S14060	
$1.50	**$1.30**	**$1.10**
D.P.D.T. 3A connectors.....	S14061	
$1.95	**$1.75**	**$1.30**
S.P.D.T. 12V Coil 10A 240V	S14114	
$4.95	**$3.95**	**$3.75**

HIGH INTENSITY RED LED BAR GRAPH

Dimensions:
Overall: 63mm across, 5mm high.
LEDs: 10 x 5mm x 1mm

Cat.No.	1-9	10+
Z10180	**$2.95**	**$2.75**

SPECTROL MULTIDIALS

MODEL 15-1-11

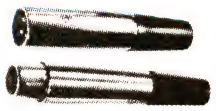
Number of turns: 10
Minor Scale Division: 1/500 turn
Shaft Bore: 6.35mm (¼")
Finish: Satin Chrome
Body Size: 25.4 x 44.45mm (1 x 1¾")
Depth: 25.4mm (1")
Weight: 45.4g (1.6oz.)
Cat.R14405 ..... **$45.95**
SPECIAL, $35.95

MODEL 16-1-11

Number of turns: 15
Minor Scale Division: 1/50 turn
Shaft Bore: 6.35mm (¼")
Finish: Clear Anodize
Body Size: 22.2mm diameter (.875")
Depth: 22.2mm (.875")
Weight: 19.8g (0.7oz.)
Cat.R14400 ..... **$26.95**
SPECIAL, $21.50

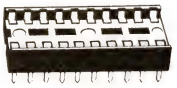
MODEL 21-1-11

Number of turns: 15
Minor Scale Division: 1/100 turn
Shaft Bore: 6.35mm (¼")
Finish: Satin Chrome
Body Size: 46.04mm diameter (1.812")
Depth: 25.4mm (1")
Weight: 85.g (3oz.)
Cat.R14410 ..... **$46.95**
SPECIAL, $37.50



CANNON TYPE CONNECTORS

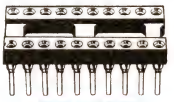
1-9		10+
P10960	3 PIN LINE MALE.	
$3.90	.....	**$3.50**
P10962	3 PIN CHASIS MALE	
$3.00	.....	**$2.50**
P10964	3 PIN LINE FEMALE	
$4.50	.....	**$3.90**
P10966	3 PIN CHASIS FEMALE	
$4.95	.....	**$3.95**



LOW PROFILE IC SOCKETS

Save a small fortune on these "Direct Import" low profile IC sockets! PCB mounting solder tail. Dual wipe. All tin plated phosphor bronze or berryllium and dual wipe for reliability.

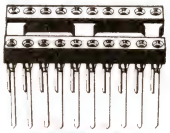
Cat.No.	Description	1-9	10+
P10550	8 pin	**$0.20**	**$0.15**
P10560	14 pin	**$0.25**	**$0.20**
P10565	16 pin	**$0.35**	**$0.20**
P10567	18 pin	**$0.40**	**$0.30**
P10568	20 pin	**$0.40**	**$0.30**
P10569	22 pin	**$0.40**	**$0.30**
P10570	24 pin	**$0.40**	**$0.30**
P10572	28 pin	**$0.50**	**$0.40**
P10575	40 pin	**$0.50**	**$0.40**



GOLD INSERT LOW PROFILE IC SOCKETS

- Gold machined pins
- Extremely high quality
- Anti-wicking.
- Ideal for professional use or where field service of components is required.

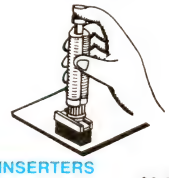
Cat.No.	Description	1-9	10+
P10620	8 pin	**$1.20**	**$1.10**
P10624	14 pin	**$1.60**	**$1.50**
P10626	16 pin	**$1.90**	**$1.80**
P10628	18 pin	**$2.00**	**$1.80**
P10630	20 pin	**$2.20**	**$2.00**
P10632	22 pin	**$2.40**	**$2.20**
P10634	24 pin	**$2.60**	**$2.40**
P10640	28 pin	**$2.90**	**$2.60**
P10644	40 pin	**$3.00**	**$2.70**



WIRE WRAP IC SOCKETS

These quality 3 level wire wrap sockets are tin-plated phosphor bronze.

Cat.No.	Description	1-9	10+
P10579	8 pin	**$1.50**	**$1.40**
P10580	14 pin	**$1.85**	**$1.70**
P10585	16 pin	**$1.95**	**$1.80**
P10587	18 pin	**$1.95**	**$1.80**
P10590	20 pin	**$2.95**	**$2.70**
P10592	22 pin	**$2.95**	**$2.70**
P10594	24 pin	**$3.95**	**$3.50**
P10596	28 pin	**$3.95**	**$3.50**
P10598	40 pin	**$4.95**	**$4.50**



IC INSERTERS

14-16 pin T12187	**$8.95**
18-20 pin T12189	**$8.95**
24-28 pin T12191	**$9.95**
36-40 pin T12193	**$9.95**

NEW TRANSISTORS

Rod Irving Electronics have two new transistors which will replace a multitude of common hard to get devices.

The PN100 is a NPN general purpose medium power amp and switch with continuous collector current up to 500mA.

The PN200 is a PNP general purpose amp at collector currents to 1 Amp.

Both are TO-82 plastic package

PN100 REPLACES:
PN2221, PN2222, PN2222A, PN3585, PN3568, PN3569, PN3643, PN5133, 2N2219A, 2N2222A, 2N3414, 2N3415, 2N3416, 2N3417, 2N3700, 2N3704, 2N3904, 2N4123, 2N4124, 2N4401, 2N5088, 2N5210.

PN200 REPLACES:
PN2907, PN2907A, PN3638, PN3638A, PN3640, PN3644, PN4121, PN4143, PN4248, PN4249, PN4250, PN4355, PN4916, PN4917, PN5910, 2N2905A, 2N3467, 2N3702, 2N3906, 2N4125, 2N4126, 2N4291, 2N4402, 2N4403, 2N5086, 2N5087, 2N5447.

PN100 Cat. T90001
PN200 Cat. T90002

1-9	10+	100+
$0.20	**$0.18**	**$0.15**

Rod Irving Electronics

MELBOURNE: 48 A'Beckett St
Phone (03) 663 6151

NORTHCOTE: 425 High St
Phone (03) 489 8866

CLAYTON: 56 Renver Rd
Phone (03) 543 7877

SOUTH AUSTRALIA
Electronic Discounters P.L.
305 Morphett St, ADELAIDE
Phone (08) 212 1799
NOTE: [illegible]

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Interstate Orders: (008) 33 5757
All Inquiries: (03) 543 7877

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P.O. Box 620, CLAYTON 3168
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$500 plus	$12.50

The above postage rates are for basic postage only. Road Freight bulky and fragile items will be charged at different rates.

All sales tax exempt orders and wholesale inquiries to:
RITRONICS WHOLESALE
56 Renver Rd, Clayton
Ph. (03) 543 2166 (3 lines)

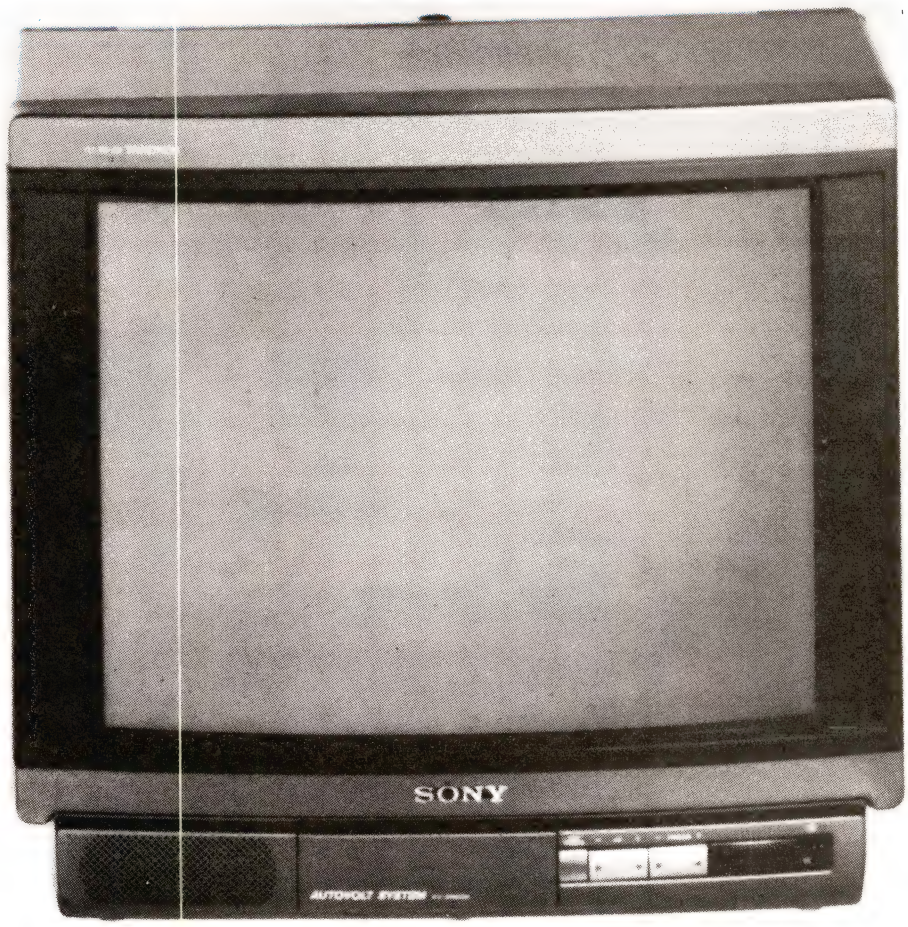
Excess and unpaid amounts are refunded. Prices and specifications subject to change without notice. All [illegible] are subject to availability. Mail order [illegible] Quantity limits may apply to some items. Quantities may be limited to stock on hand. Some items may be shown for illustration purposes only.

MasterCard VISA

3RD BIRTHDAY CONTEST No.4.

Video fans – cast a Captain Cook at this!

Imagine winning this magnificent monitor-style 48 cm Sony Super Trinitron black screen TV, model KV-1982AS, worth $1149.



This stylish black-finish 48 cm TV receiver features Sony's Super Trinitron system, which uses an Aperture Grill screen in conjunction with a new computer-designed Panfocus Gun. Sony's one-gun three-beam technique is fundamentally different from the shadow-mask system used in most TVs, and is designed to produce sharper, brighter images with more precise colour, and freedom from the unpleasant "doming" effects which cause colour impurities.

The screen is flat and square-cornered, and includes an on-screen display to make the full-function infrared remote control even easier to use. Video (BNC) and audio (RCA) inputs are supplied for true monitor capabilities.

Prize kindly donated by Sony Australia.

CONTESTS CLOSE 31 OCT. 1988

1) Which came first, the Cathode Ray Oscilloscope or Electronic Television?

. . . . . .

2) In what year did Sony commence manufacturing televisions?

. . . . . .

3) Would you expect the aperture grille or conventional shadow mask television system to produce a clearer picture?

. . . . . .

Now, in 25 words or less, explain why you would like to win the Sony KV-1982AS Monitor Style Television.

I have read the rules of the contest and agree to abide by their conditions.

Signature: _____

Name: _____

Address: _____

_____ P/Code: _____

Phone: (___) _____

NAD Super Receiver combines separates in one chassis

A tuner, phono preamp and power amp, three of NAD's Monitor Series stereo separates, are combined in their new 7600 Remote Control Receiver which becomes the basis of a superlative stereo system — just add sources and speakers!

The power amplifier section is sold separately as the NAD 2600. Rated at 150 watts per channel RMS, its 'Power Envelope' circuitry delivers 400 to 800 watts per channel of dynamic power, depending on speaker impedance. These high power levels are available for hundreds of milliseconds to provide for the dynamic peaks of digital sources.

The phono preamp section is the same as that in the Model 1300 preamp. Its eight-transistor, FET-input MM stage is immune to radio-frequency interference and has a dynamic range of 112 dB, NAD claim. Its MC imput is a class A pre-preamp measuring 10 to 15 dB quieter than many separate pre-preamp units, they say.

The tuner, the same as that on the Model 4300, has an FM noise-reduction circuit which pulls in stereo signals free of noise and distortion, according to NAD. Manual tuning is achieved by a knob operating an optical shaft encoder to generate pulses for the digital tuning circuit.

Functions include volume, balance, tuning (eight pre-sets or automatic station search), input selection (six inputs), and power on/off. Volume is provided not by the voltage controlled amplifier circuits often employed in remote controls but by actuating a miniature motor on the volume control shaft, avoiding the noise and distortion of the VCA circuits.

Further details from **NAD Australia, 28 King St, Rockdale 2216 NSW.**

Test tapes for audio & video

Wagner Electronics has released test tapes for both audio and video cassette recorders, with the tests varying from a test of tape speed to everything necessary for the professional to align the record/playback heads.

The Australian-made AAC9 can perform a range of tests without other equipment or technical knowledge, such as a test of tape speed. The first six minutes of the tape is a 1 kHz sine wave, the next six minutes is a 5 kHz sine wave, then a 2.5 kHz sine wave suppressed for 10 seconds each 10 seconds.

The LC Engineering range is aimed at the audio tradesman. Each tape is a master, not a duplicate, and each is individually produced, tested and numbered.

There are six models which test head alignment, tape speed, signal-to-noise ratio, wow and flutter. They are priced at $19.96 and from $36 to $39.95 respectively.

The two video cassette test tapes are aimed at the professional, with the VID50 designed to test for fault diagnosis. Costing $49.95, it contains a 30 minute colour bar signal and 1 kHz audio tone.

The VID70 has everything necessary for video alignment, including sweep for head alignment, an eight minute RF sweep followed by eight minutes of colour bars with 3 kHz audio tone, then an eight minute staircase with monoscope, 333 Hz audio tone and a six minute crosshatch, testing input-output linearity. Cost is $115.

The tapes are available from **Wagner Electronics, 305 Liverpool Road, Ashfield 2131. (02)798 9233.**

Camcorders popularity

Sharp Corporation has conducted a survey of recent purchasing trends which found that more than 30 000 Australians will buy a home video camcorder this year.

Eighty percent of those surveyed said they bought a camcorder because they considered moving film gave them a better record of their children growing up and holiday trips than a still camera.

A boom in the home video market over the past few years has resulted in more than 60 per cent of homes having a VHS home video recorder.

The survey revealed that with the increase in camcorder popularity, electronics companies had introduced new technology to make them more efficient and simpler to use, Sharp said.

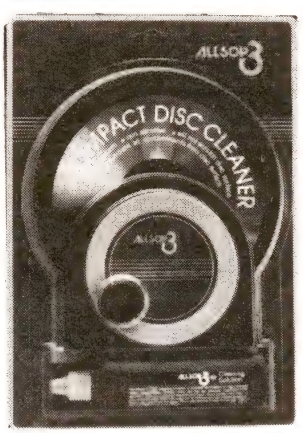
CD cleaner

Allsop has announced its latest accessory – the Allsop Compact Disc Cleaning System.

Whilst CDs are not as sensitive to contamination as vinyl discs, small particles of dust and dirt can cause CD players to skip or repeat passages apparently at random.

The Allsop system uses a patented wet process that mechanically sweeps hundreds of non-abrasive fibres in a radial motion outwards from the centre, as recommended by CD manufacturers.

The cleaning system comes with three replacement cleaning pads and a large bottle of cleaning fluid. For more information contact **Allsop Fidelity Accessories, PO Box 246, Double Bay 2028 NSW. (02)357 2022.**



The Japanese stand back and the Koreans move in

Roger Harrison

Over all the years of the Perth Electronics Show, the Japanese companies dominated the exhibition, just as they dominated the marketplace. This year's show, the Koreans put on a "show of force", while many major Japanese companies were not in evidence.

THE ANNUAL Perth Electronics Show, billed as the largest show of its type in the southern hemisphere, never fails to draw huge public attendances by eastern states' show standards, and has annually served as a springboard for new products not destined for release for up to 12 months following the show.

This year, the shows's tenth, was no exception. Held over the 13th to the 17th of July, it attracted bigger crowds than last year, although exhibitors' numbers – just over 100 companies – and space booked were both down on last year; while the main pavilions were well-booked, some six of the smaller pavilions lining Claremont Showground's concourse were uninhabited this year. Attendances this year were up on 1987 figures, with around 63 000 surging through Perth's Clarement Showgrounds to see some 100-plus exhibitors.

The Show started life as, mostly, a hi-fi show ten years ago, just before consumer video and office automation arose from the international electronics conglomerate. Quite early in the piece, it developed into a "true" consumer electronics show; when the video games boom arrived, it hit Perth first, and again with the home computer and home video booms (both continuing unabated!).

This year's "flavour"

This is the sixth Perth Show I have been to in succession, and while clearly a consumer show in past years, and remaining largely so, this year saw a significant swing to business and office automation equipment on exhibitors' stands. Faxes, photocopiers, phone equipment, business computers, printers and mobile cellular radio telephones – the cellular phone system opens for operation in Perth this month – were in abundance.

Nonetheless, consumer goods dominated – TV and video being clearly "hot items" this year. Hi-fi remains a big element of the Show and a big attraction with the crowds. And judging from what I saw and heard at this year's show, surround sound is set to "take off". Kenwood, Yamaha and NEC all had systems on display, not always under ideal conditions.

It was a disappointment that a number of major consumer electronics marketers did not exhibit this year; for example JVC, Panasonic, Akai, Sharp, Pioneer and Philips. Many of the well-known smaller companies who provided so much special interest in the past were missing, too; like Falk Electrosound, Scan Audio and etc. However, a number of new faces appeared, so the Show lives up to its reputation of always delivering a few surprises.

Video and TV provided most of the "action" this year. For your garden-variety TV receivers and VCRs, this year the major Korean makers clearly "moved in". Goldstar and Samsung each had a range of current products on display, along with some products to be launched over the next 12 months or so.

Samsung made their first appearance last year, and this year took a substantial stand, displaying an increased range of products, including a 26" TV receiver, video players and VCRs and compact disc players.

How long before videophones are in our homes? Probably a long time, but that didn't hold back the crowds who queued to get a go on a pair of Sony videophones like these.

Kambrook also took an enormou stand, half of which was devoted t Goldstar products, with a range of TVs music systems, VCRs and vide players. Australia is the only country i the world where this Korean electro nics giant has authorised the use of it name. In Europe and America, the "brand name" products for other com panies.

For the couch potato brigade, we have –

Just when you thought TV and vide technology had reached its zenith, th manufacturers launch new product de velopments promising yet more "im provements".

In television receivers, the trend (o is that "trends"?) this year is toward MONSTER screens and tiny portables The 33" and 34" (how's that for one upmanship!) monster screens are nc rear- projection technology, but us large cathode ray tubes as in your ga den variety TV.

The Koreans have definitely arrived. Samsung mounted an impressive stand in a commanding position.

Sony, ever a company to move with the times, if not ahead, had new products in both monster and mini areas, displaying a new 34" black screen Super Trinitron receiver – great for those blockbuster video movies – and a "Combo" receiver/VCR, the EV-DT1. This will go on-sale late this year, or early 1989.

It features a 6" colour Trinitron screen and the inbuilt 8 mm VCR includes the usual features such as still-frame and slow motion, timer (with data displayed on-screen) etc. It comes with an infra-red remote control and a wake-up alarm facility and operates from mains or DC (e.g. car battery).

Sony also foreshadowed their new "Watchman" video, a tiny tuner and 8 mm video player with 3" colour liquid crystal screen. They had pictures on-show, but sadly no product.

In small TVs, there's a new product name to the market, Rover, imported by Nation-Wide Imports from Sydney. They showed-off quite a spectacular variety of small portable TVs, ranging from a 10" AC/DC model billed as ideal for home, car or boat, to a compact 6" screen colour TV that operates from internal batteries, AC mains or 12 V DC, weighing just 2.5 kg.

If you want it "all" in portable entertainment, Rover has a "ghetto blaster" with 4.5" B&W TV built in! It sports a stereo dual cassette deck, AM/FM/SW/LW radio and a 4-band graphic equaliser, not to mention the pair of two-way speakers and the TV!

NEC, joining the monster screen TV bandwagon, displayed a 33" model, the ST-7800. This features a flat-square screen which allows viewing over a wider angle than conventional screens, plus a picture-in-picture facility for viewing another channel or viewing a TV channel while using your VCR, as well as stereo hi- fi sound. And it's ready for Super VHS when it arrives later this year.

The monster screen TVs won't be cheap, expect to pay in the vicinity of $2000-plus. They will start appearing in the stores from September – or earlier, if the distributors can get enough product to pass around.

While JVC and Panasonic are making big waves about the coming of Super VHS, neither company had a stand at Perth this year and Super VHS was left unpromoted. Tsk, tsk!

Sony, not missing an opportunity, had the first ED (for "extended definition") Beta VCR and receiver on show in this country. While the system on-show used the American/Japanese NTSC TV system which gives 525 lines vertically and runs at 30 frames/sec (where our PAL system runs 625 lines vertically and 25 frames/sec), it gave stunning results on the 29" TV.

The clarity is measured by how many lines can be clearly resolved across the screen. Broadcast TV gives 330 lines, normal Beta about 250 lines, but this NTSC system ED-Beta gives phenominal 500 lines resolution! In the PAL system, Sony spokesman Gary Beauchamp says ED-Beta will achieve around 580 lines resolution.

ED-Beta, like Super VHS, separately records and process the chrominance (colour) and luminance (brightness) signals. It requires a special metal video tape, however.

The VCR on-show was the EDV-900, a fully-featured VCR sporting a frame "jog" knob as on Sony's current top-line Beta models. An ED-Beta camcorder is also in the wings. Sony expect the first PAL system ED-Beta machines to appear here late in the first quarter of next year.

Goldstar, along with their "standard" line of video and TV products, included a few items in the "lets run up the flag and see how many salute" category. What caught my attention was a TV/VCR 2-in-1 combo, sporting a 19" screen and VHS 2-head VCR with short-play/long-play facilities and unified remote control for both TV and VCR. However, it lacked a timer. Include that, and I'd say they'd have a winner.

In camcorders, Sony has a new SportsPak for their CCD-V40 camera that protects it from water, sand, dust etc, while you shoot in the great outdoors, around the pool, at the beach etc. It's not meant for diving, like their Marine Pak.

Sanyo previewed two new Video8 camcorders, one featuring a 1/2000th second shutter speed the second, ▷

Sony has always maintained a major presence at the Perth Show, and this year stole a march on their competitors, who stayed away. They had an impressive line-up of new video and audio gear that will be released over the next 12 months.

Half the gigantic Kambrook stand was occupied by Goldstar products. Apart from their video and audio equipment, these Goldstar IBM XT and AT compatibles attracted considerable attention. These machines sport an impressive array of features as standard and and will be aggressively priced and marketed.

featuring shutter speeds ranging from 1/100th to 1/4000th second. The latter also has a title inserter allowing you to put titles at the beginning or end of the a recording in white, blue, red, yellow or black. Both are due for release in October.

A new TV receiver development we're likely to see a lot more of is the "double-scan" screen, and Sony (ever the innovator) had it on display. Basically, this system takes each frame received (that is, one screen), stores it and this is then scanned onto the screen before the next frame comes along. Thus, twice the number of frames per second are displayed, eliminating the flicker that is normally evident, though slight.

Some people are more sensitive to this flicker than others. It all depends on an effect known as "the persistence of vision", which gives the illusion of motion though our eyes are presented with a series of static images. At or below about 25 images per second, we begin to perceive flicker, particularly in peripheral vision, hence doubling the frame rate on a TV, even though the image only changes every second frame, eliminates the perceptible flicker.

Sony has combined the double-scan technology in their receiver with a "digital clear" feature that compares the picture signal in each frame with the stored frame, reinforcing the "regular" picture signal and attenuating the "random" or irregular noise that is present. This improves the clarity and the colour and Sony had two receivers side by side, one with double scan and digital clear, the other a normal set. The effect showed clearly a worthwhile improvement.

Surround sound

NEC made surround sound a major feature on their stand this year, deploying it in conjunction with one of their giant rear-projection TV receivers as it is expected the video "home theatre" will be one of surround sound's biggest applications.

NEC's systems can provide four types of sound: *Dolby Surround* - for those room-shaking special effects on video movie sound tracks like the Indiana Jones series, Star Wars, Top Gun etc; *Hall Surround* reproduces the ambience of a live concert hall – great for music records and tapes, and older movies; *Matrix Surround* creates the effect of being in a stadium – use it with sports telecasts and rock concerts; the last, *Creation Surround* uses four speakers placed in front of the listeners, where the other three systems use two in front and two behind – and this is said to dramatically boost the stereo effect. Most surround sound systems offer similar choices.

NEC showed five surround sound components, two offering Dolby and Matrix – the A1300E Unified Audio Visual System and the AVR700 Surround Receiver, two offering Dolby Matrix and Hall Surround – the AV250 and the AV350 amplifiers, and one offering all four systems – the AVD-700E Surround Decoder.

With a surround sound setup in conjunction with a video and large screen TV, and one of the war movies on – those helicopters really fly right overhead!

I heard a Kenwood surround sound system being demonstrated courtesy of Perth's Arena distributors all on its own in a small pavilion away from the hustle and bustle. And it was stunning! I sat through parts of Rambo and Top Gun, but Ry Cooder's sound track on the cult blues movie "Crossroads" sure made my hair stand right on end!

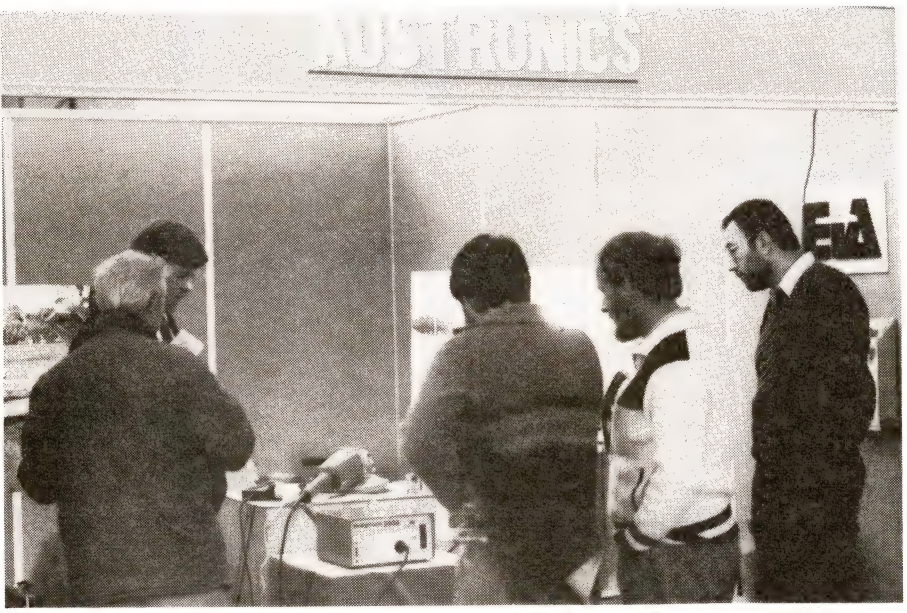
Accessories

But the Show isn't all about the "giants" of the industry, grand equipment and big bucks. You can see the latest in accessories, too.

A relatively new entrant to the market, and a new exhibitor this year, was Amaray International with a variety of record, tape and CD care accessories, including a cassette deck cleaner, an ingenious cleaner for vinyl discs – important now as replacement will be difficult if not impossible in a few years – and a compact disc cleaner that removes dust, fluff and other surface contaminants.

Algebra Holdings, another new entrant to the Show and to the accessories market, was kept busy demonstrating a

The Bose Acoustic Wave Cannon, slung above the heads of the crowd, occasioned oohs and aahs of awe – and the odd rear-end collision! The beast is meant for use as a subwoofer in theatres and PA systems where real, tummy-rumbling bass is required.



A 12 Vdc to 240 Vac inverter manufactured in Perth by Austronics drew considerable attention in the West Australian Industry pavilion.

range of imported cassette tape and compact disc storage systems soon to be widely available through hi-fi and electrical stores. Managing Director, Leo Overington, is no stranger to the hi-fi market (or to the Perth Show for that matter), having been with Pioneer in the west for many years. He's also marketing a range of locally-made cabinets from Bodman.

If you've followed the overseas hi-fi press this past year, you will have noticed the many accolades and awards being clocked-up by "That's" audio cassette tapes. Now they're in Australia! That's International, based in Perth, has launched on the local market and had a stand at the Show, drawing considerable attention from both trade and public. The company plans to devote substantial effort to establish the product name here over the next 12 months. Keep an eye on the name, the product seems to convert "try anything once" customers in a trice, according to all reports.

OA, w-p & etc

While so-called office-automation products crept into the Perth Show a few years ago, some companies displaying a few of their high-tech copiers, word processors and the like, this year "OA products", to use the jargon, were prominent on many major stands.

Canon, Sanyo, NEC and AWA had major displays, all cheek by jowl with their consumer gear. But I must confess that I really had to work hard to find the "hot" new products here.

NEC had a small section of their substantial stand devoted to computer equipment, principally showing-off their recently released multi-sync monitors, and promoting their CD-ROM drive.

AWA had the QMS ColorScript 100 printer out for its first public showing. It's a thermal transfer type colour printer that features four-colour process printing with colours that match the Pantone colour set as used by offset printers, QMS claim.

Aimed at the desktop publishing market, it prints on plain paper or transparencies with a resolution of 300 by 300 dots per inch, using the popular PostScript software. It comes with thirty five standard fonts and a downloadable font capability is provided. Four interfaces are provided – RS232, RS422, Centronics parallel and Apple Talk, so it can be used with Apple Macs plus IBMs and compatibles.

AWA see the QMS ColorScript 100 as a rival to colour laser printers, with its PostScript capability, lower capital cost and lower running costs, according to QMS.

Kambrook's Goldstar division previewed their XT and AT model IBM compatibles, due for general release here this month. Manufactured in Korea, they will be aggressively promoted to the business, educational and home markets, according to a company spokesman, billed as "Goldstar, from Kambrook". They will be offering a full 12 month warranty and an optional five year "Goldcare" service cover at competitive prices. The company will also be marketing 3.5" and 5.25" floppies here in the popular formats.

Goldstar will be a company to watch in the office automation market. I understand they will coming out with faxes and telephone products, sporting popular features, aggressively priced and heavily promoted.

Again this year, one pavilion was devoted to West Australian industry exhibitors. Perth manufacturer, Power Filtration Pty Ltd, a member of the Compusoft Group of Companies, previewed an uninterruptible power supply aimed at computer users. Interruptions to the mains power, though sometimes so brief as to pass unnoticed, can bring disaster to computer equipment, clearing the data held in the computer's volatile memory. No fun for anyone who's experienced it.

Due for release in the last quarter of the year, it is to be sold at a much lower price than competitive units currently on the market, according to Nigel Timperley from Power Filtration.

Steve Wroblewski of Austronics took a stand for the first time, displaying the Magnum 2000 240 Vac inverter he manufactures in Perth and is now exporting. This marvel generates 240 Vac 50 or 60 Hz, from a 12 V vehicle battery and will deliver a claimed 600 volt-amps continuously, 1 kVA intermittently and 2 kVA on surge.

This means it has enough "grunt" to power-up many items that pull a surge of power on startup, or intermittently during use, such as power tools, refrigerators, microwave ovens etc. It features auto-start operation and comprehensive protection, all housed in a very rugged case.

Novelties

Every year or so, a real novelty will surface at the Perth Show. This year, it was a pair of videophones from Sony. They proved an attraction with the crowds, displayed on a separate stand along with some "relics" of past telephone technology.

These videophones can be used over the existing telephone network and provide a still, black and white image on a small screen, showing who's on the other end of the line. The image takes nine seconds to appear after you pick up the receiver, as it employs a "slow scan" imaging technique. The image is then stored in memory and the display continuously updated, so that you see a complete, still picture. No on-sale date was available. Videophones, I think, will be more of a novelty consumer product than a business "tool".

Bose had an attention-getting novelty on their stand. They slung one of their "acoustic wave cannons" above the walkway. This monster bass loudspeaker (or should we say "reproducer") is 300 mm in diameter and nearly four metres long! It exploits the principle employed in the "acoustic-mass" subwoofer of their Project X speaker system launched last year. It has a driver mounted inside the tube about three-quarters of the way down. One end of the tube is open, from which the sound radiates.

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How to make successful home videos

Part 2

Dave Jeanes

Recording your video movies is great fun. Getting someone to watch them afterwards is the hard part! Cutting out the awful bits, covering the disastrous parts of the sound track with music, editing together two or more separate tapes – all of these things can be done to improve viewer reaction, and give you greater satisfaction.

GETTING YOUR SHOTS on tape is only half the job. Assembling and editing them into a coherent "whole" completes it. *Then* people will likely watch it and give you the praise you well deserve! But, first things first.

There are certain aspects of a video recording that must be taken care of before any editing can take place. Perhaps the first one is to ensure you always purchase good quality video tape; buying a known brand name will ensure the tape will not clog your video heads, and will be free from noise, dirt, dropouts and other imperfections.

For home movie making, buy a 60 minute (preferably) or 120 minute tape. Your movie will seldom exceed 30 to 40 minutes in length, and the shorter tape will be easier for your camera transport to handle for stop/start recording.

If the movie you plan to make is very important, insert a new video tape in the recorder and run the camera in the 'record' mode with the camera lens cap on, and a blanking plug (spare plug without cables attached) inserted in the mic. socket to cut out ambient sound, (embarrassing if you have coughed or spoken ill of a neighbour during this procedure). Run it for sufficient time to more than cover the proposed length of the movie. This action will record a synchronising track, plus black video onto the tape.

The reason for this is twofold. Firstly, cameras with digital tape counters or time readout in minutes and seconds will continue to supply the readout even if you over-run the last recorded point. This will allow you to re-position the tape accurately.

The second benefit is realised if you use the camera's 'insert edit' facility (a very helpful facility which allows accurate re-positioning of the tape after playback). Accidently winding past the last recorded segment will then give only a few moments of black screen, rather than a distracting period of noise and instability in the picture.

The final caution is regarding the start of the video. If 'black' video has been recorded as suggested above, advance the tape for 30 seconds before commencing the new movie. If the tape is blank or has been used before, insert a blanking plug into the microphone auxiliary socket, which will open the microphone circuit. Record for 30 seconds with the camera lens cap on, then switch off and you are ready to commence your video movie.

The reason for preparing this 30 second leader is to avoid recording your movie on the first few feet of tape, which may have become dusty or damaged when being spooled up frequently into the machine. Also some VCRs will use up more tape than your camera uses in the loading sequence. If this happens, on playback you could miss the first few vital seconds of your video.

To avoid a ragged, picture tearing start to your movie, after loading the tape into your recorder (with black video recorded on it), advance in the 'play' mode for about 25 seconds, press the 'pause' button, then the 'record' button. When you are ready to start the recording proper, release the 'pause' button and the recording will start with a clean cut from the 'black' leader. If your opening camera shot starts with a fade-up from black, the effect will be great.

VCR rear panel connections

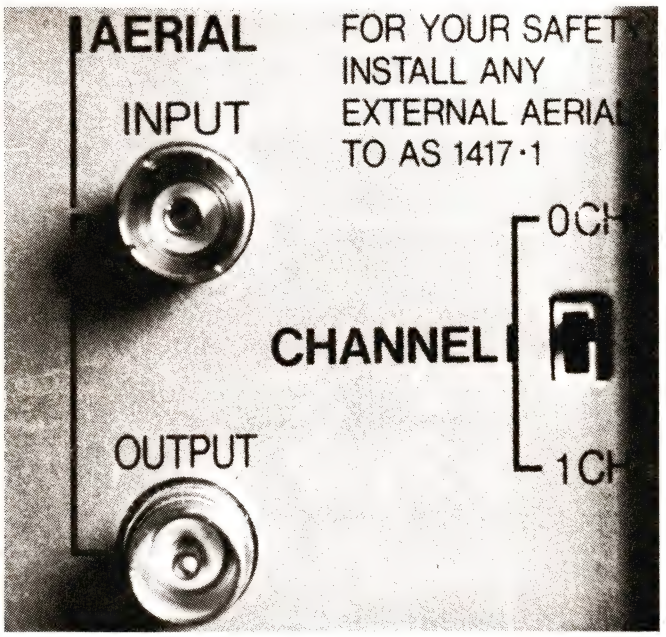
Most VCRs will have three pairs of sockets on the rear panel. One pair (Belling-Lee type) will be marked 'Antenna Input' and 'RF Output'. The female 'antenna input' socket has a hollow centre pin. The other two pairs are RCA sockets (sometimes called phono sockets), and are labelled 'Video/Audio IN' and 'Video/Audio OUT'. In some older sets these sockets are BNC types, which have a push-in-&-twist bayonet action.

The vital difference in the use of the sockets is that the Antenna and RF sockets handle video and audio signals which are combined together at VHF (or UHF) frequencies. At the RCA sockets, the two types of signals are separated into their basic frequencies of video and audio information. When utilising these latter sockets, it is possible to modify either the video or audio (or both) when copying the programme into another VCR.

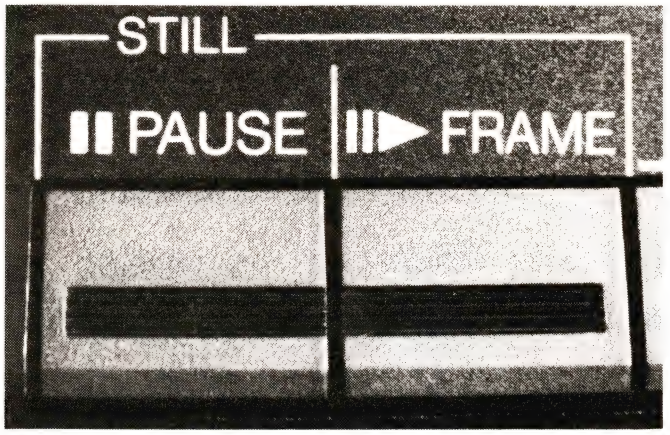
Copying a video tape

All that is required to copy one video tape onto another video tape is a playback machine and a recording machine. Some camera-recorders have the ability to play back a video tape. They will have either a Belling-Lee type socket (output on a VHF or UHF channel) or Video/Audio OUT RCA type sockets (or perhaps both types).

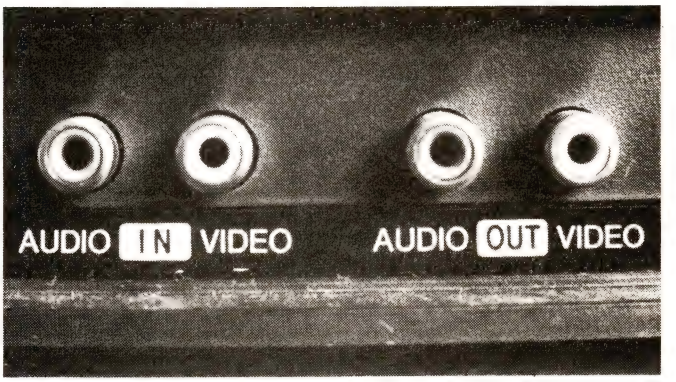
The recording VCR should have its RF Output connected to the TV set, so you can monitor the proceedings on the TV screen. If there is channel compatibility between the two VCRs, i.e: the output of the playback machine (generally VHF Channel 0 or 1) can be tuned into by the recording machine, then connect a Belling-Lee type coaxial cable between the



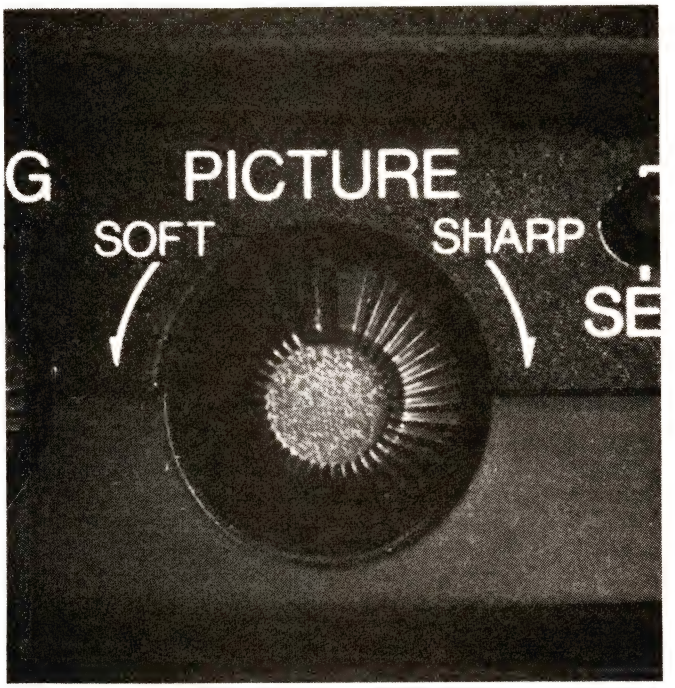
Belling-Lee type coaxial cable sockets on rear of VCR. The Output socket provides video and audio signal combined together, on either Ch 0 or Ch 1 (selected by small slider switch).



Typical Pause and Still Frame buttons on a VCR. Pressing and releasing the Pause button in the edit mode allows clean joins to recording.



RCA (Phono) type sockets fitted on the rear panel of most VCRs. The audio output, being separate from the video, can be modified by mixing music and speech, when dubbing a copy.



Turning the Soft-Sharp knob to Sharp allows the playback picture clarity to be enhanced slightly.

playback machine RF output and record machine Antenna input.

It may be necessary to play the tape on the playback machine for a few minutes to adjust the channel tuning controls of the record machine to get the best picture (on CH 0 or 1). To prevent inadvertent erasure of the playback tape (a real risk), remove the small tab on the label edge of a VHS tape cassette, or on the underside edge of a Beta tape cassette. When you want to record again with that video tape, stick a small piece of adhesive tape over this tab hole.

If the VCRs do not have compatible VHF channels (some older VCRs have only UHF channel output) then it will be necessary to connect the Video/Audio sockets of the two machines together, using appropriate cables available from most video or electronics stores (e.g: Tandy or Dick Smith). This system will give slightly better results, particularly if the playback tape has marginal quality (it could also be a copy).

Take care to ensure the playback machine Video/Audio OUTPUT sockets connect into the recording machine's Video/Audio INPUT sockets. With the TV set tuned to the recording VCR output channel, immediately the playback VCR is set to 'Play' the picture should come up on the TV set. If not, check the position of the TV/VCR switch, often fitted on some recording VCRs.

Editing the copy

If the whole of the playback tape is wanted, start one machine to 'Play' and the other to 'Record' (removing the protective tab from the playback cassette case will avoid accidental erasure if you get mixed up at this point). The video and audio circuits of the recording machine will automatically adjust for the correct signal level during recording.

Your ability to edit out some sections of the playback tape depends on the sophistication of your recording VCR. If this VCR has a 'Pause' button, pressing this button when the VCR is in the record mode will stop the recording action, yet still allow the playback picture to be visible on the TV screen. When you wish to re-commence recording, press the 'Pause' button again and recording will re-commence.

The acid test now is to play back the newly-recorded tape to see if the section omitted by use of the 'pause' button has given a clean cut, with no picture disturbance. If the cut is clean, then you have a potential to do some advanced editing. ▷

Editing from several tapes

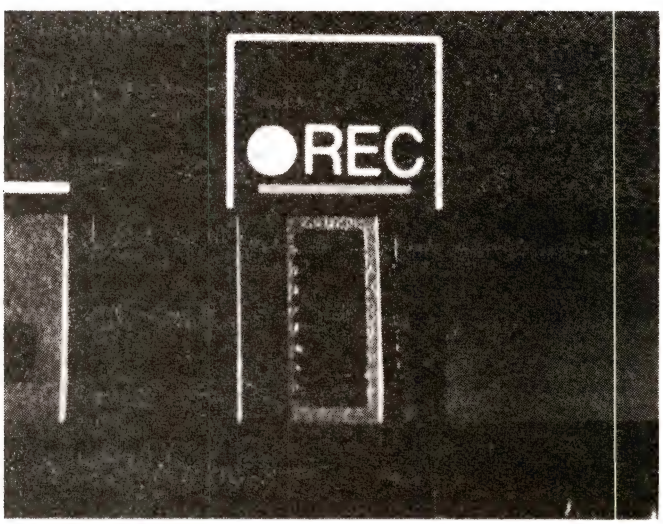
Sometimes it is desirable to bring together into one recording, segments of various video tapes. You have seen how you can stop and start the recording VCR using the 'Pause' button. Most VCRs can stay in the recording 'pause' mode for several minutes. This period will give you time to spool up a second video tape into the playback machine, and then to join some of its content to the segment you have just recorded. If your VCR has a digital tape counter, cueing up the various tapes before an edit session will give a smooth flow to the task.

For accurate editing it is necessary to know how much delay or over-run occurs during your VCR's edit functions. One way to determine this is to set up a clock (with a second hand) in front of your camera, and record several minutes on tape. On playback in your editing VCR, go into the 'Pause' mode when the clock's second hand is on, say, 12 o'clock. Press the 'Record' button, then release the 'Pause' button. Allow the VCR to run for, say 15 seconds in the record mode, then rewind and view the results.

What you will probably find is that the edit has been made several seconds before the 12 o'clock position. This is because the tape rewinds when the 'Pause' button is pressed (referred to as back-track editing), then advances again when the 'Pause' button is released, but re-recording does not commence again for a few seconds. You can ascertain the length of this 'gap' by noting the position of the clock's second hand when the cut takes place. If the second hand jumps when it reaches seven seconds before 12 o'clock, then your VCR edits at a point seven seconds before you pressed the 'Pause' button. To offset this, during playback let the scene run on for seven seconds (six is safer) AFTER the desired edit point, before you press the 'Pause' button.

Modifying the sound track

Some camera-recorders will have an 'Audio Dub' facility, whereby the sound can be erased from the sound track and new sound recorded without interfering with the picture signal. A simple way to record music onto the sound track is to switch to the 'audio dub' mode and play music on a cassette deck located near the camera microphone. This method will also record a high background noise and any voices etc, and also cause acoustic feedback (a howling sound) via the TV set speaker.



The Record button sets the VCR to record and starts the tape rolling.

A better system is to use a patch cable between the 'line output' socket of a cassette deck and the microphone socket on the camera. Have your TV set connected to the VCR with the volume control set for normal TV listening level. Adjust the volume control (it may need to be turned almost right off) of the cassette deck to give clean audio from the TV set speaker during a test run of music. When 'dubbing' sound in this way the original sound track is lost for all time. Sound dubbing cannot be accomplished with Video 8 format recorders, because they record the sound track using the rotating video head, rather than the fixed audio record head employed on Betamax and VHS VCRs.

When patching two VCRs together at VHF or UHF frequencies, the video and sound are combined and cannot be separated. However, when using patch cords between the Video/Audio IN and OUT sockets, the audio can be modified.

Dubbing music and narration

The simple way to do this is to have an audio cassette machine playing music near the camera-recorder microphone. Having prepared your commentary and turned the recorder to 'audio dub', speak the commentary at the appropriate periods, turning the music down slightly when speaking. Try to sync the start of the music with the start of the video picture, and fade up the music (using the volume control) with the picture start.

As mentioned, the original sound track cannot be part of the new sound track when using the above elementary technique. The original sound track may contain vital voices or background noise, which can add realism to your movie. To utilise it, plus music and narration, it will be necessary to employ an audio mixer. This device can be a low cost, three or four channel, battery operated unit, and its use will give a new dimension to your editing results. Low-cost units are available from electronics retailers, such as Tandy, or you could build your own, such as the "Mini Mixer" unit we described in the June 1988 issue (p.61) and sold as a kit by Dick Smith Electronics, cat. no. K-3039.

A low-cost mixer such as this Arista unit, model MM1, is what you need for later dubbing a sound track onto your recordings. Further details from Arista, PO Box 191, Lidcombe 2141 NSW. (02)648 3488

To prepare for a sound mix, work out your narration and write it down, leaving large spaces between each scene, to assist in getting the correct timing as you read it out loud. Using an ordinary audio cassette recorder, make a series of recordings of the narration whilst watching the video being played back on a TV set. When you have a mistake-free recording of the narration, get your music ready. Select the musical passage you require, and record it on a second audio cassette, using the recorder's 'pause' control to cut out the periods of silence as you re-position the pickup arm. Record a total length at least five minutes longer than your whole video movie (the music will be running for the full period of the audio mix).

The next step is to connect the audio output (RCA socket) from your playback VCR to one mixer input. Connect your audio cassette deck, which will play the background music, into a second mixer input. Into the third mixer input connect

the output from the same cassette recorder used to record your narration (this will help to ensure the tape runs exactly in time). The mixer output is then connected into the recording VCRs Audio Input RCA socket. A coaxial cable is used to connect the video signal from one VCR to the other.

You may question the need to make an audio recording of the narration. If you go ahead and speak the commentary whilst recording the video copy, and then make a mistake in the narration, you will have to start all over again, syncing-up the two VCRs and the music playback machine. Each time you are forced to re-start, your chance of making another mistake increases.

The Sony PRO camera showing the tape on the left.

The final mix

Even though you have taken the heat off by pre-recording your commentary, there are still plenty of actions to get right during the final mix. First, decide how much (black) leader to have in the new video recording. The playback machine should start up first to give the recording VCR a signal to lock onto as soon as it starts up, so both VCRs must have their tape positioned correctly.

The music cassette should be cued up to a point about one second before the opening music bars, and its 'pause' button pressed. The mixer should be switched on, and all its level controls turned right back. There should be a clue in the playback tape (even if only the reading on the VCR tape counter) to indicate when the music should be faded up.

Start the playback VCR. When it has stabilised, start the recording VCR. On cue (generally the first glimpse of picture on the TV screen) release the music cassette deck 'pause' button and fade up the music with the mixer control (you should have adjusted the TV set loudspeaker volume to the right level, beforehand).

The narration will normally commence after a few seconds of music. At the point where you want narration to begin, start the narration cassette unit and fade up the mixer level control. As the narration segments begin, fade down the music to a low, yet still discernible, level. Have a cue card ready to indicate (from the playback VCR tape counter reading) when the fader control for the original video tape sound track should be faded up and down.

Start-up check list

1. TV set speaker volume set to correct level.

2. Mixer power on and all slider controls off.

3. Cue-up music cassette deck, set to 'pause'.

4. Cue-up narration cassette deck, set to 'pause'.

5. Start playback VCR to 'play'.

6. Start recording VCR to 'play'.

7. On cue, release music deck 'pause' button and fade up music.

8. On cue, release narration deck 'pause' button and fade up quickly on mixer.

9. Fade music down, then up, as narration segments occur.

After a few minutes you will start to enjoy this new experience, because apart from the start-up, it only requires the mixer controls to be operated at the correct moments, and you will have a really professional video programme.

With a little experience, you'll find the whole process becomes easier, you'll gain great enjoyment from successfully making your own videos, and so will your audience!

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Send coupon to: 1st Floor, 347 Darling St, BALMAIN 2041 NSW

▷ from page 63.

Summarising

Last year, I thought the Show had gone "off the boil", it lacked lustre, there was no buzz. This year, I think the "temperature" rose a little, particularly in video and TV products, despite the fact that many of the major distributors – Philips, JVC, Panasonic, Toshiba, Sharp, etc – were not exhibiting. This left the field open to the other majors, NEC, Sony, Canon, Yamaha, AWA, etc.

While the Japanese majors dominated in years past, this year the Koreans established a foothold, and it looks like they're aiming to sweep through the traditional market area so long held by the Japanese – where products are priced lower and frills are fewer. Long warranties are offered to combat fears about reliability, and Korean brand names are appearing in major retailers in increasing numbers.

Consumer electronics in this country is about to undergo a transformation akin to that which happened during the 1970s when the Japanese companies moved in, capturing the market with good quality, value-for-money goods transplanting the predominently European-based equipment of the period. This time around, it's the Koreans who are transplanting the Japanese.

It was good to see a return in interest from the public, with improved attendances on last year. Perhaps, in hindsight, 1987 was the Perth Show's nadir. The show organisers report healthy bookings for 1989, with some of the "missing faces" returning already.

There's some talk of moving the Show dates later in the year, to September or October, to catch better local weather and hence attract the crowds, and to place the show closer in time to the flood of new releases that are nowadays occurring around the last quarter of the year. It could be a good move.

The Show organisation is a well-oiled machine that has the "formula" well defined and the momentum to continue with "the largest show of it's type in the southern hemisphere". Now is the time to pick up on the rising temperature of this year's show and regenerate the buzz and excitement that reigned a few years ago.

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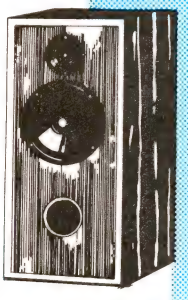
NEW SA-100 SPEAKER KIT



Since the introduction of VIFA speaker kits in Australia in 1985, thousands of speakers have been built with superb results. VIFA is now proud to release four new speaker kits ranging from a mere $399 to $1199 per pair including cabinets.

Never before have speaker kits been so popular in Australia than after the heavy devaluation of the dollar. Similar fully imported quality loudspeakers are today typically 2-2½ times more expensive. And these speakers may very well be using Danish VIFA drivers anyway, as VIFA supply more than 50 of the world's most respected loudspeaker manufacturers with drivers.

But why the big savings? Because fully imported speakers suffer from 25% import duty, 20-30% freight, 30% sales tax and 28% handling charges (typically). So if you would rather put your money into better quality than in other people's pockets, VIFA speaker kits are the only way to go.

Are they difficult to build? No, the kits are supplied with all parts needed including fully built crossovers and pre-cut flatpack cabinets ready to assemble. No soldering or carpentry skills are needed, just a Phillips head screwdriver, some simple hand tools and a few hours of your leisure time.

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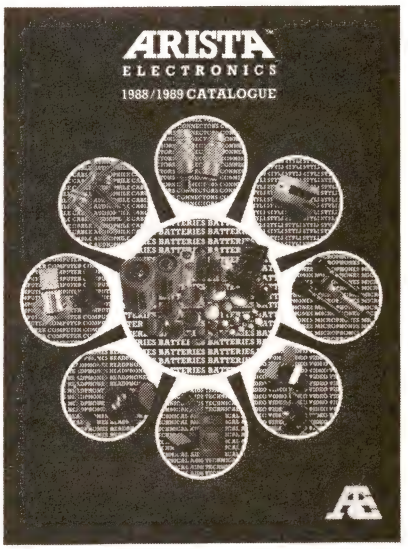

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Win these four great Dick Smith kits

Win these first-class kits from Dick Smith Electronics – so good your friends won't believe you built them!

These top-line "high tech" kits will provide the winner with units equivalent to or better than the expensive commercial built-up alternatives, with the priceless bonus of the satisfaction of "doing-it-yourself".

Prizes kindly donated by Dick Smith Electronics; value – almost $1000!

The **K-6315 Teletext Decoder** brings you a wealth of information on your TV screen. The Teletext signal is already being transmitted to millions of homes around the country, carried on the "unused" lines between TV frames and thus normally "hidden". Only those with expensive Teletext TVs, or decoders such as this one can unlock the hidden signals.

News pages and reports on many various activities are broadcast, with one of the most significant services being the provision of captions to popular programmes. This service for the deaf or hearing impaired is available on programmes which display the Caption Centre logo. Do you like a "flutter" on the races? Get your betting information on Teletext!

The Teletext decoder is designed to operate into a standard home VCR, but can be used without one if you build the **Teletext Tuner (K-6319).** This device takes the decoder output and feeds it straight to your TV for no-fuss reception of the teletext material. The kit is simple to build, with very comprehensive instructions, and tuning is a simple matter of selecting the right channel. The tuner can even be built into the Teletext Decoder for maximum utility.

The **K-3437 1 GHz Digital Frequency Meter** provides specifications unheard of in commercial units of only a few short years ago, but with an assembly technique ideally suited to home construction. Frequency measuring range is from 20 Hz right up to a stunning 1000 MHz!

Hi-Fi with maximum convenience is yours with the **K-4003 IR Remote Control Preamp** kit. Not only do you get an eight-input hi-fi preamp with oodles of indicator LEDs and an output suited to most amplifiers, but you get full control over it with a 21-button IR remote control. So sit back, put you feet up and let your fingers do the walking!

CONTESTS CLOSE 31 OCT. 1988

1) Where in a television transmission is the teletext information located?

. . . . . .

2) Name the last three Managing Directors of Dick Smith Electronics, in chronological order.

. . . . . .

3) What product from Dick Smith Electronics has the catalogue number N-1081 and what other product would you use this with?

. . . . . .

In 25 words or less, why do you want to win these four kits from Dick Smith Electronics?

I have read the rules of the contest and agree to abide by their conditions.

Signature: _____

Name: _____

Address: _____

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New Goldstar DMM range at Geoff Wood Electronics

Geoff Wood Electronics has in stock, right now, three models of the new Goldstar range of handheld digital multimeters, ranging in price from $88 to $188.80.

These Goldstar instruments re made in Korea by Lucky-Goldstar, one of the largest electronics outfits in the country. The gency to distribute their instruents was recently obtained by lmeasco (see our story this nonth in *News Review*).

All three instruments have 1/2-digit displays and feature utoranging, a rotary function elector for volts-current-esistance and recessed input ockets. Each will read to 10 A ac r dc.

Bottom of the range is the M6135; the DM6235 features a nemory function and range old, while the DM6335 has all nat plus a data hold facility.

Gallop over to Geoff Wood lectronics, 229 Burns Bay Rd, ane Cove (on the corner of Beatice St), 2066 NSW. (02)427 676.

555s for 25 cents!

Melbourne's newest electronics retailer, The Electronic Components Shop, at 289 atrobe St in the city, which akes over from Active Electronics, has specials on a number of Cs currently, including 555s for 5 cents!

Part 1 of an article series on his versatile timer IC is the feature of this month's cover, in ase you hadn't noticed.

The 555 is suited to a whole ost of timer and oscillator applications, and is widely encountered in projects and electronic quipment. Better stock up while he going's good!

The Electronic Components hop also has a range of other opular ICs on special: like 324 uad op-amps at 25 cents, 741 p-amps for the same price, 2764 EPROMs for $5 and Z80 microprocessors at $3.

Low-cost two-way speaker

Eagle Electronics in Adelaide has released a low-cost two-way speaker kit they claim to be ideal for the audio enthusiast on a limited budget, or perhaps suited to experimentation with surround sound systems.

By combining two reasonably priced Arista drivers, a two-way crossover and Vifa two-way 60/60 speaker cabinets, Eagle has put together a speaker system with reasonable performance for a minimum cost.

The full kit for a pair of speakers will set you back just $269. Further details from **Eagle Electronics, 54 Unley Rd, Unley S.A. 5061. (08)271 2885.**

Bubble Etcher gets a heater

Sesame Electronics has added a heater to their Bubble Etcher printed circuit etching tank so that, instead of throwing the etchant away after it cools down, you can heat it up again and etch more pc boards.

The Bubble Etcher is a clear acrylic tank, holding the etchant in a narrow vertical slot. Bubbles are pumped into it by an air pump and the movement of the fluid rinses away the dissolved copper, etching the board in a few minutes, according to the makers. No stirring is required.

The addition of the heater solves the problem of reheating the ammonium persulphate; it may be left in the tank and the thermostatically controlled heater is used to bring it to the right temperature when you want to use it again.

The Bubble Etcher is part of a line of equipment from Sesame for making pc boards in small quantities. More details from **Sesame Electronics P/L, PO Box 452, Prahran 3181 Vic. (03)527 8807.**

High value poly capacitors

Polycarbonate and polyester metallised film capacitors in the microfarads range are ideal for audio applications, particularly in loudspeaker crossovers.

Melbourne retailer All Electronic Components stocks a range of these capacitors in a variety of high capacitance values and selling for reasonable prices.

We picked up some on a recent trip to Melbourne and can attest to their quality. Some are of Siemens manufacture, others from Roederstein ('ERO'). Voltage ratings range from 100 Vdc to 630 Vdc.

We obtained some 5u6/100 V polycarbonates priced at $2.00 and 3u3/250 V polyesters priced at $2.50. Well worth a rummage round the corner from Russell St. **All Electronic Components, 118-122 Lonsdale St, Melbourne 3000 Vic. (03)662 1381.**

PROJECT BUYERS GUIDE

This month's feature projects will be readily available as kits from Dick Smith Electronics. The **AEM2521 Versatile Lab Supply** is to be stocked as a complete kit, while the **AEM6510 Guitar Practice Amp** will be stocked as "electronics only", leaving you to organise your own cabinet.

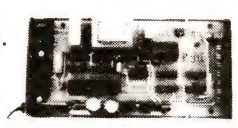
If you're organising your project from scratch, then you'll find the components required are fairly widely available. The only "specialised" components are the LM204, LM336Z-2.5 and the SPDT centre-off spring-return one-way switch for the Lab Supply. The LM204 is a National Semiconductors part, but in this supply the LM304 may be substituted here as the input is under 40 V. The 304 you'll find stocked by Geoff Wood Electronics in Sydney and Stewart Electronic Components in Melbourne. The LM336Z-2.5, another National part, used in the Crowbar and Thermal protection units, is stocked by these stores, too, as well as Ritronics in Melbourne. The switch is a little unusual with a spring-return on one side, but this feature is not essential. Try your favourite supplier. SPDT centre-off switches are widely available, however.

You should have few problems obtaining parts for the Guitar Practice Amp. The LM383/TDA2002 can be supplied by Geoff Wood Electronics in Sydney and Stewart Electronic Components in Melbourne. It's also stocked by Tandy stores, part no. 276-703.

Printed circuit boards for this month's projects will be available through All Electronic Components in Melbourne.

BUILD THE DATAMODEM M1200 MODEM.

As described in May '88 AEM.



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The "Pug-Nose" guitar practice amp

Rick Jones
Roger Harrison

Here's a rugged, portable, low-cost guitar practice amp that delivers good sound at good volume and is easy to build.

EVERY GUITARIST of the electric persuasion, casual or serious, has faced the dilemma: how to get in some practice wherever and whenever some time can be "stolen" from other pursuits, without raising the ire of neighbours but at the same time getting satisfactory sound. A guitar practice amp needs to be readily portable yet deliver adequate volume and 'good sound', and it needs to be rugged enough to survive being dragged around, slung in car boots, under beds, trodden under foot in the backs of cars – you name it! When we looked at this, it also seemed like an ideal recipe for a busker's amp, too.

For portability, battery operation is the obvious requirement, so we needed an amplifier with reasonably low quiescent current drain but good power output, capable of running from a supply of between six and 12 volts. Being a guitar amp, it would also need to be rugged electrically, to withstand being driven into clipping for sustained periods. Low cost and simplicity (the KISS approach to design – "Keep It Simple, Sam!") were further considerations. Sort of a tall order!

An IC "block" power amp was clearly indicated and the LM383T/TDA2002, which was used in the audio output stage of the AEM3520 VHF Weather Satellite Receiver published in our February 1988 issue, came to mind. This fulfilled the requirements admirably, as one of its main design applications was in ". . . the extremely harsh automotive environment . . ."

Made by a number of manufacturers, it is generally known under the *National Semiconductor* (USA) part number of LM383T, as well as the Euopean semiconductor manufacturers' (SGS/ATES, ITT, Thomson-CSF etc) part number, TDA2002. The accompanying Data Sheet, elsewhere in this issue, details the device's characteristics. From this you can see that it will work over a wide supply voltage range, can drive loads as low as 1.6Ω (five 8Ω speakers in parallel!) and will withstand high temperatures, output overloads and repeated supply transient voltages without damage. It will deliver a power output of 3-4 watts from a nominal 12 V supply into a 4Ω load and has a typical quiescent current of 40 mA at that supply voltage. It's an inexpensive device, has only modest heatsinking requirements and needs a minimum of external components, keeping the cost low.

Well, that solved the fundamental problem. Now all we had to do was find a suitable low-cost loudspeaker, "interface" a guitar and devise some housing.

The output

A wide variety of speakers may be used, of any size (according to your circumstances), and virtually any available impedance. While 8Ω impedance speakers are common, a 2Ω ▷

Rick Jones, co-author of this article, does draughting and production here at AEM, as well as some project construction. But they aren't his only talents. Rick is also the founder and leader of the well-known band "Ol' 55", in which he plays lead guitar and vocals. That's him on the left! Rick formed Ol' 55 in 1975; the band has had a few hit records to its credit over the years and still plays regularly.

or 4Ω speaker would be better, permitting the LM383 to deliver more output. However, 2Ω speakers are relatively rare.

If you're not going to reproduce the project more or less as described, the choice of speaker is wide open. If you want a really *compact* amp, then a miniature 50-60 mm "transistor portable" speaker is the go, but don't expect much in the way of volume or "sound". They're inefficient and have restricted frequency response, particularly at the bass end. However, accepting the compromises, you could pack your practise amp into a small diecast box, powered from a 9 V battery (but a No. 216 would not be expected to last too long!)

At the other extreme, 8" (200 mm) or 12" (300 mm) speakers have more sensitivity – that is, they're easier to drive – than small speakers, contrary to what you'd first expect. They'll sound louder than smaller speakers, all else being equal.

For this application, a compromise on size is necessary (for portability), and with a bit of "umming and aahhing" we settled on finding a 4", 5" or 6" speaker that measured up to the other requirements. What's required in a guitar practice amp such as this is a speaker having a medium compliance (stiffness of the cone suspension), good sensitivity and adequate frequency response, particularly at the bass end of the guitar range. Ruggedness and price are also part of the equation.

Size, compliance and sensitivity all conflict here. Smaller diameter speakers need a long voice coil "throw" and thus low compliance to achieve good output and extended low frequency response. Searching for a suitable compromise was the next task.

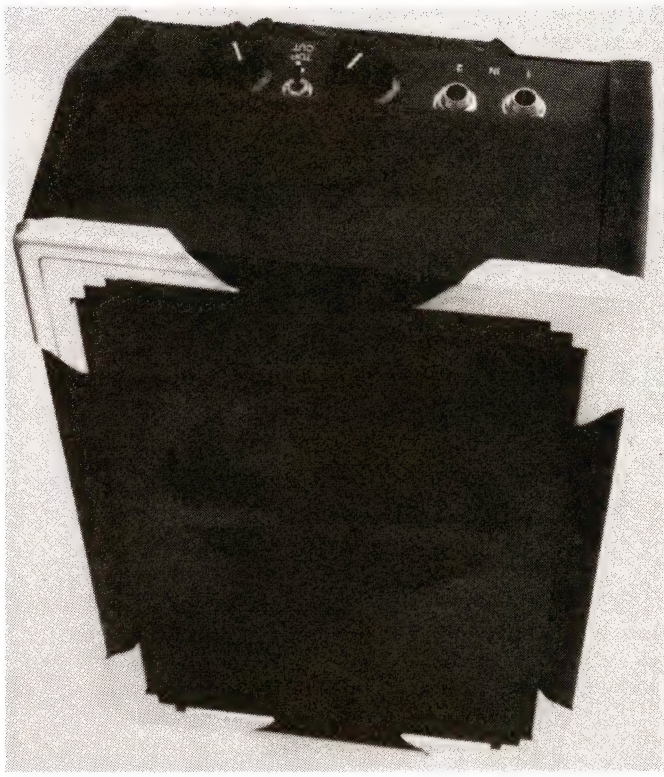
We didn't have to search too far. Sydney's "Silicon Alley" – York St in the city, where four electronics retail stores cohabit cheek-by-jowl, proved a fruitful searching ground. With the best part of 100 models of all sizes to choose from, we found more than a dozen in the size range settled on, a number of which we'd had some experience of already, and rejected. Following consultation with the proprietor of David Reid Electronics, Des Bain, we investigated several drivers in the Arista range, finally settling on the model MR10, a 4" (100 mm) unit that delivered the goods in pretty well every respect *and* was economically priced at under $15. Better still, thanks to Arista's wide distributor network, it's widely available.

While the MR10 has an 8Ω voice coil impedance, it has good sensitivity, compensating somewhat for the reduced power output available from the LM383T/TDA2002 when driving loads of this impedance. It proved to have ample output in practise and adequate frequency response. It's rated at 10 watts, which means it's unlikely you'll burn out the voice coil in this application.

In addition, the MR10 has a frame that encloses the rear of the cone, and this has a number of advantages. Firstly, it means the speaker can be placed in any housing, open or closed, and its basic characteristics will be unaffected. Secondly, it won't be prone to bass end rolloff due to radiation from the rear of the cone cancelling radiation from the front due to the relatively short distance in terms of the wavelength of sound at the lower frequencies. This is a problem with all open frame speakers used 'naked' or on a comparitively small baffle. The MR10's construction allows it to be mounted any which way, which in this application means in a small box.

The input

A guitar pickup typically has an output in the order of a few millivolts to maybe twenty millivolts or so. However, the LM383T's input sensitivity is typically 50 mV for full output, given a gain of 40 dB (100 times) with the recommended feedback resistors. Clearly, some amplification ahead of the LM383 was necessary. In keeping with the KISS approach, a single transistor preamp stage would meet the bill. A quick "lash up" proved this and gave us the chance to incorporate some distortion to give some "guts" to the sound of the practice amp.



A simple common-emitter amplifier, biased so as to have a very low collector current has significant distortion at quite modest ac gain levels. As the ac gain of the stage is determined by the ratio of the resistance in the collector (the collector load resistance) to the unbypassed resistance in the emitter, simply by providing variable emitter bypassing, one can vary the amount of distortion, albeit varying the stage amplification at the same time.

Here, part of the preamp's emitter resistance is provided by a potentiometer (RV1), with a capacitor connected between the wiper and common. The greater amount of emitter resistance that's bypassed, the greater the ac gain and the greater the distortion. In addition, the low frequency (bass) response improves with increasing emitter bypassing, giving a bass-boost effect as the distortion is increased – something of an advantage in this application, actually.

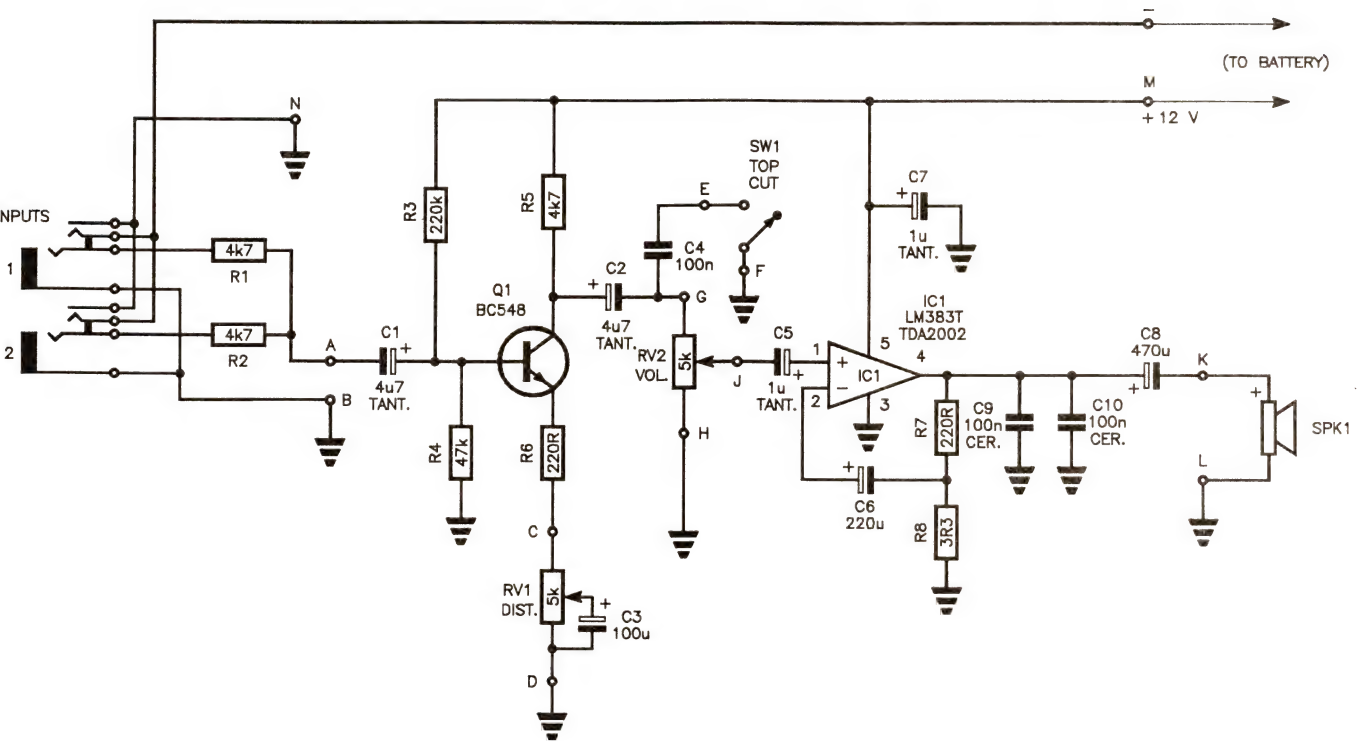
The variation in the preamp stage's amplification is readily compensated for by placing a volume control after the preamp. Not an "ideal" arrangement, but simple. As the controls on a guitar amp are generally set "to taste" and not continually varied, such an arrangement is no great drawback. For such a simple arrangement, it proved to work well.

To add some versatility, a second input was considered desirable, so provision was made for a second input with simple resistive mixing at the input to the preamp. In addition, a "top cut" switch was added at the output of the preamp, to roll off the high frequencies above 2 kHz.

The housing

More argument raged over the housing than any other single aspect of the design! Orthodoxy says "put it in a box". You can suit yourself. Rick's building one into a modified four litre plastic motor oil 'can'! The final prototype was housed in a simply-made, rugged, but good-looking (well, *we* think so!) box.

A Saturday morning's browse around the local hardware

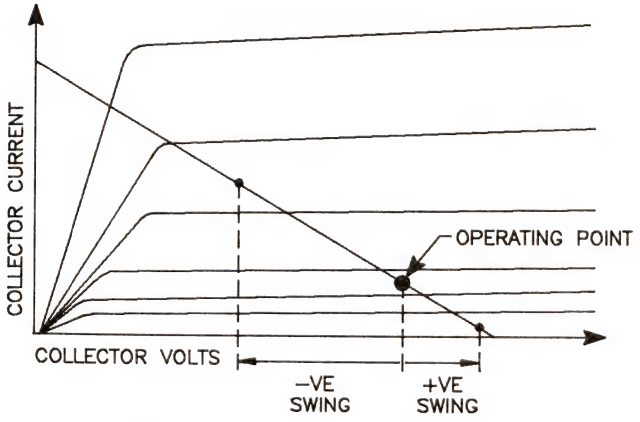


CIRCUIT DESCRIPTION

The circuit consists of a preamp stage, involving Q1, followed by a "block" power amplifier, IC1, an LM383/TDA2002, to drive the speaker. Power is derived from a 12 V battery.

The preamplifier comprises a common-emitter amplifier employing a relatively high gain transistor, Q1 — a BC548. This stage is capacitively coupled at the input (C1) and output (C2). Two input jacks are provided, signals from both sources mixing at the preamp input via R1 and R2. Mixing levels can be adjusted by means of the usual level control fitted on electric guitars.

Q1 is biased, via R3/R4, such that the quiescent collector current is very low, placing the transistor's operating point in a very non-linear region of its collector characteristic curves, as illustrated in the diagram here. The positive and negative swings of collector voltage resulting from signal current swings at the base, will be unequal, resulting in distortion at the output. Distortion is much lower at more moderate base current excursions.



The gain of the stage is determined by the ratio of its collector circuit resistance to that portion of its emitter circuit resistance which is in the signal path, that is, the portion which is unbypassed. This ratio is varied, and thus the distortion, by varying the emitter resistance bypassing. RV1 forms part of the emitter resistance, with the bypass, C3, connected to its wiper. Varying RV1 varies the amount of emitter circuit resistance bypassed, thus varying the gain and the distortion. Simple, but effective.

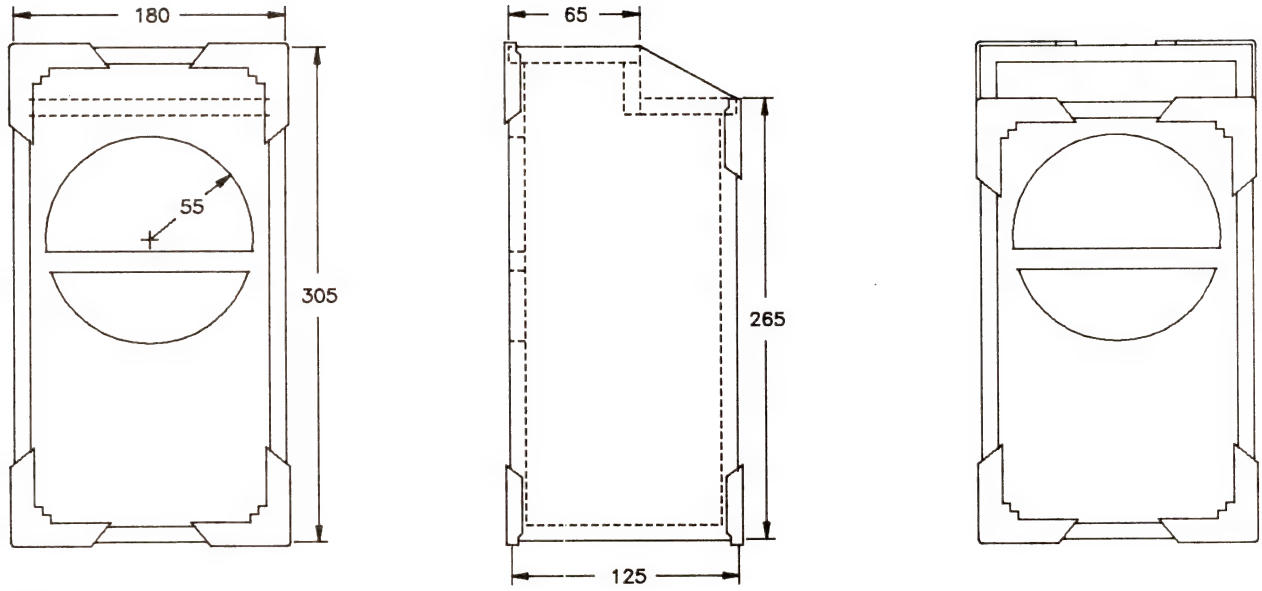
The drawback is, the output signal level also varies. However, because you generally set the distortion to produce the sound required, a volume control following the preamp can then be used to set the speaker volume. At this point, capacitor C4 can be switched in to provide some attenuation of the "top" frequencies of the guitar, hence SW1 is called "top cut".

The signals from the output of the preamp are coupled to the non-inverting input of IC1 via capacitor C5. The gain of IC1 is about 37 dB, set by the feedback resistors R7, R8. Capacitor C6 dc isolates the feedback path. The output to the speaker is dc-isolated by C8 as IC1's output sits at about half the supply rail voltage with no signal, swinging above and below this with signal applied.

The two capacitors C9 and C10 provide high frequency stability for IC1. Two 100n capacitors are used to make up the required 200n (0.2µThese must be very low inductance types to achieve the required low impedance at high frequencies, hence 50 V ceramic disc or monolithic ceramic types are specified. Capacitor C7 bypasses the positive supply pin of IC1.

The printed circuit board layout is a critical factor in the performance of the LM383/TDA2002. The input ground and output ground must be separated, only joining at pin 3 of the IC, and C9-C10 must return as close as possible to pin 3. The metal tab must be grounded to the output circuit ground. The best way to ensure this is not to trust the heatsink to do it, but use a solder lug beneath the bolt head that holds the tab to the heatsink. Any other arrangement will result in an unstable amplifier, at the very least, or a very good oscillator running at some frequency well above the audio range! The tell-tale indication of this condition is a very hot heatsink with no signal applied and lousy sound output with signal.

On/off switching is effected by using switch jacks on the input, wiring the two switch sections in parallel.



Cabinet details. It is made from 13 mm chipboard. The corner pieces, as explained in the text, are hardware items for fly-screen door corners. The panels may be held together with panel pins. Epoxy glue may be used in the joints to provide additional strength, and to fill the gaps somewhat.

store located a likely group of 'components', and with a bit of thought and a few hours work with saw, router and hammer, it was done! It's made from a 900 mm length of 300 mm wide by 13 mm thick chipboard. The 'corners' are aluminium corner pieces for fly-screen doors, purchased for 35 cents each at the hardware store! They not only serve to protect the corners but also hold the box panels together – and they give it the 'right' appearance!

The hole for the speaker, you will notice, has a 'bar' across it, placed a little off-centre. This serves to provide some protection for the speaker cone (from the occasional boot or other object that might be directed its way) and can be used to mount a magnetic "pickup" coil in front of the speaker's voice coil for slaving the practice amp into a full-blown guitar amp or PA.

This little trick allows you to set up the sound you want on your practice amp and to couple it into another amplifier without making a direct connection to the practice amp. This avoids hum loops and gives a more "faithful" pickup of the sound set up.

So where did the name come from? Someone commented that it looked like one of those snub-nosed dogs sitting on its haunches – a pug! Hence, "Pug-Nose".

Cabinet construction

For those building the cabinet or box shown here, all the dimensions are given in the accompanying drawings which show the front, side and rear elevations. If you're housing the project in something else, skip down to the electronic construction details.

For a slick result, the best way to make the cabinet is to mark up one of the sides with a pencil, cut it out and smooth the edges, *then* use that as a template to mark out its opposite number. This way, you get a more accurate copy and consequently a better fit for the parts. Use this method to cut the top and bottom pieces. Cut the top piece into two parts to form the ledge where the controls will mount.

Now temporarily assemble the side, top and bottom panels using the corner pieces. Lay the assembly on the remaining piece of chipboard plank front side down and carefully run a pencil along the inner edges of the side, top and bottom panels between the corner pieces. Lift off the 'skeleton' cabinet and complete the lines, marking where the top and bottom ends are.

Carefully cut out the front panel blank and then mark out the speaker cutout. Leave out the bar if you don't envisage needing it, otherwise, mark it in too. Its *exact* size and position is not particularly critical. The bar on the prototype is about 15 mm wide and its top edge about 10 mm low of the centre line.

The speaker hole was cut out with an electric router, by far the easiest way to do it, and it produces the neatest result, whether you're cutting out a plain round hole or the barred hole shown here. The alternative is to drill a series of holes around the inside edge of the marked-out hole, then break out the unwanted part. The edges are then filed smooth with a half-moon file and then sanded to finish.

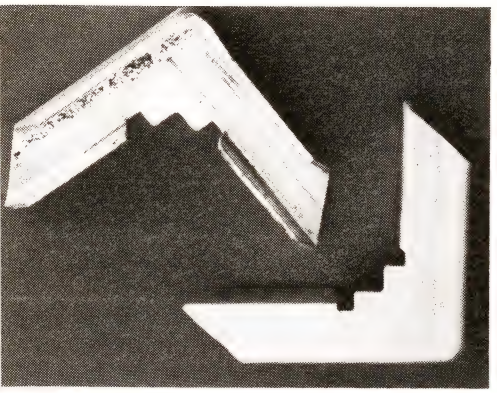
With the front panel completed to this stage, push it in the skeleton cabinet and, on the front face, run a pencil around where the corner pieces touch. Take the front panel out and carefully file notches about 2 mm deep in the edges where you marked. When you think they're about right, put the front panel back in and check. You may need to repeat this several times to get a good fit.

Avoid the temptation to nail it all together at this stage! Cut another piece of chipboard for the vertical face of the top rear ledge. The ledge piece itself is held in place by two aluminium corner fittings and you will have to file a small cut-back to accommodate them where the slope meets the vertical rear edge of each side panel – see the accompanying photograph.

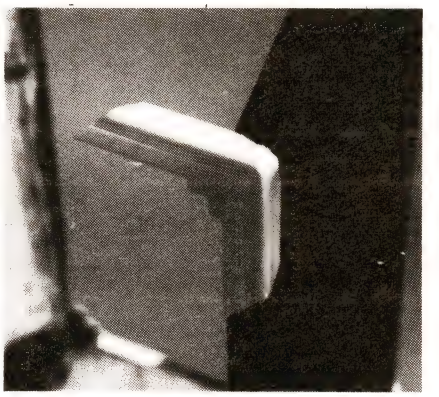
The ledge has a large slot removed in the middle, to accommodate the pots, jacks and switch which mount on a small aluminium panel that is screwed or glued down on the top face of the ledge. The pots, jacks and switch don't have enough threaded mounting shaft to mount them directly on the ledge. The size of this slot to be cut in the ledge will depend on the actual dimensions of the components you use. The arrangement is clearly seen in the accompanying pictures. You can use the panel artwork reproduced here as a template to mark the component positions and then work out the overall width and length of the required cutout.

The outer surfaces and edges of all the panels may now be painted. First, sand them lightly with a medium-fine sandpaper, particularly all the edges. Dust them thoroughly before applying paint. Our prototype was sprayed matte black. Make sure you cover the inside rim or rims of the speaker hole. Follow the paint manufacturer's instructions to get a good finish. Alternatively, cover the panels in stick-on vinyl or "Contac". Suit yourself.

The speaker can now be mounted to the front panel. Using



The corner pieces used on the cabinet are aluminium pressings made for corner pieces on fly-screen doors, costing about 35 cents. They are a push-fit on the cabinet here, serving to hold it together as well as protect the always-vulnerable corners of the cabinet.



A small cut-back in the sloping edge of each side panel is required to accomodate the corner piece that holds the ledge at the top rear of the cabinet.

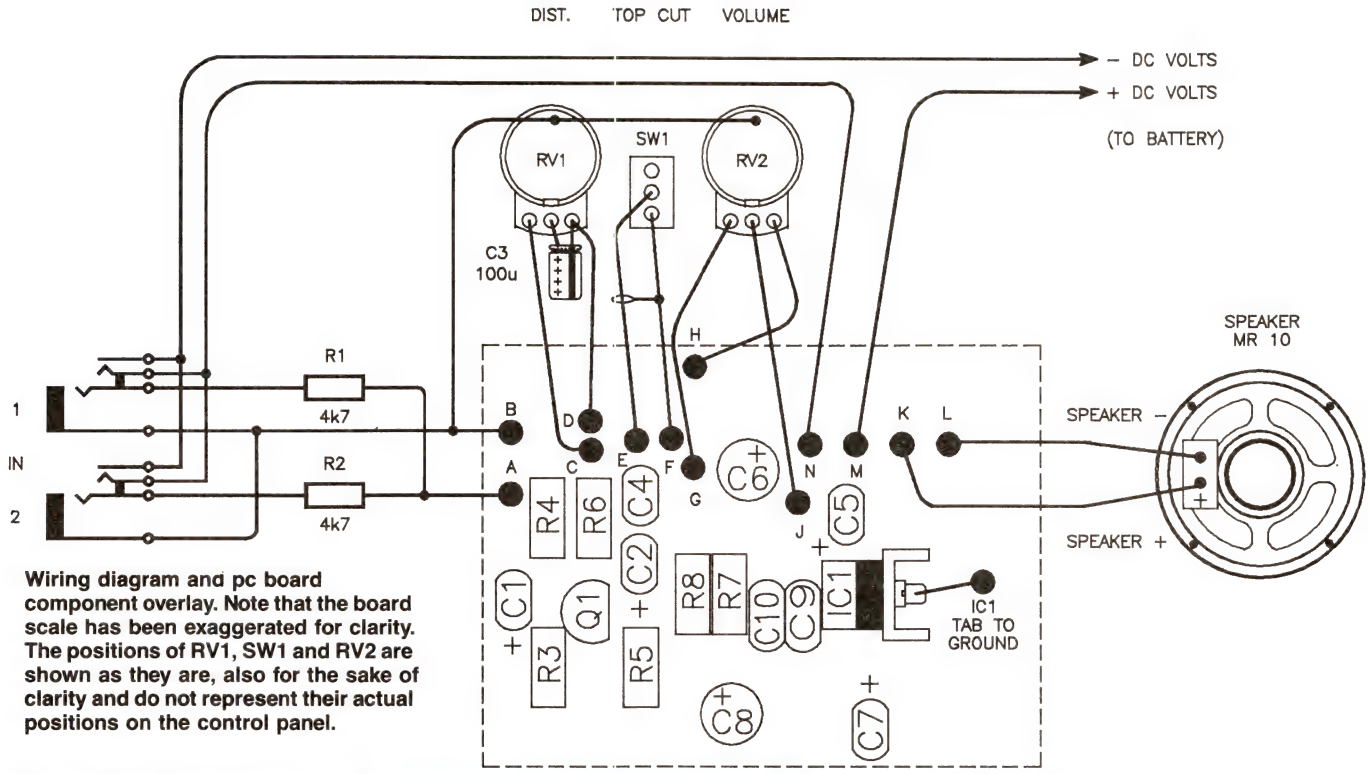
The 'skeleton' cabinet – just the two side panels, top and bottom, all held together by the corner pieces. This is used as a template to mark out the front panel.

The completed front panel, with speaker mounted, assembled into the skeleton cabinet.

t as a template, hold it carefully in position on the rear face f the front panel and mark the screw hole positions. Drill hem carefully "on the skew" so that the screws angle into he wood, away from the hole. Screw the speaker in place.

You might like to use fly screen mesh to cover the front anel after painting and assembling the speaker. Cut a piece f mesh somewhat larger than the front panel. Lay the mesh lat on the table or bench top, place the completed front panel face down on it and line it up. Wrap the mesh over the rear of the panel, side by side and staple or tack it in place as you go, stretching it slightly to keep it taut. Cut off the excess. The mesh will make the panel a tight fit in the cabinet, but that's an advantage, anyway.

With all the bits and pieces finalised, *now* you can tack the cabinet together. Panel pins are quite adequate. A bead of epoxy glue run along each joint just nefore you assemble ▷



Wiring diagram and pc board component overlay. Note that the board scale has been exaggerated for clarity. The positions of RV1, SW1 and RV2 are shown as they are, also for the sake of clarity and do not represent their actual positions on the control panel.

AEM6510 PARTS LIST

Semiconductors

Q1 ..... BC548
IC1 ..... LM383T or TDA2002

Resistors all ¼W, 5%

R1, R2 ..... 4k7
R3 ..... 220k
R4 ..... 47k
R5 ..... 4k7
R6, R7 ..... 220R
R8 ..... 3R3
RV1 ..... 5k lin. pot.
RV2 ..... 5k log. pot.

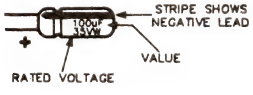
Capacitors

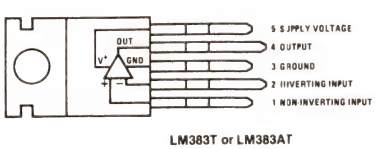
C1, C2 ..... 4u7/35 V tant.
C3 ..... 100u/16 V electro.
C4 ..... 100n greencap or MKT
C5 ..... 1u/35 V tant.
C6 ..... 220u/16 V RB electro.
C7 ..... 1u/35 V tant.
C8 ..... 470u/16 V RB electro.
C9, C10 ..... 100n(0.1u)/50 V monolithic or disc ceramics

Miscellaneous

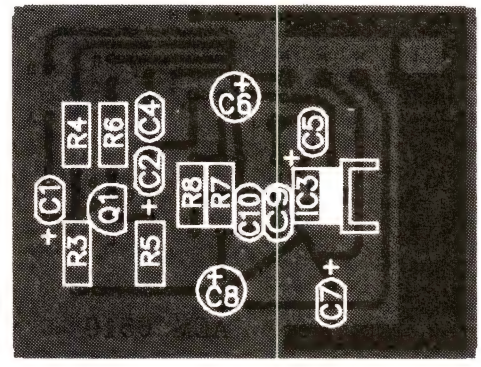
AEM6510 pc board; SW1 – SPST miniature toggle switch; SPK1 – Arista MR-10 4" (100 mm) speaker; two small pointer knobs; two 6.5 mm switch jacks; pc-mount heatsink to suit IC1; solder lug; pc "pins" or "stakes" (optional); length of 22 gauge tinned copper wire; hookup wire; short length of screened cable; battery connectors to suit; cabinet parts as required (see text), front panel, Scotchcal, screws, panel pins etc.

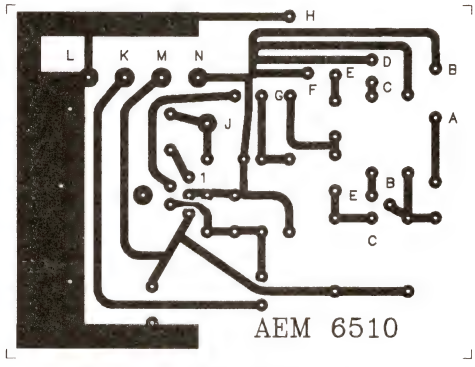
Estimated cost: $38 – $44 (excluding cabinet)



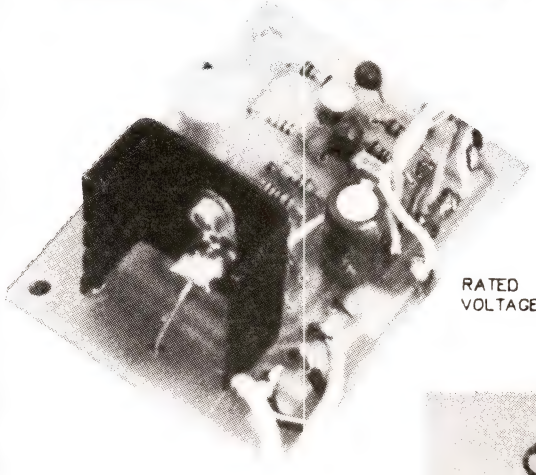


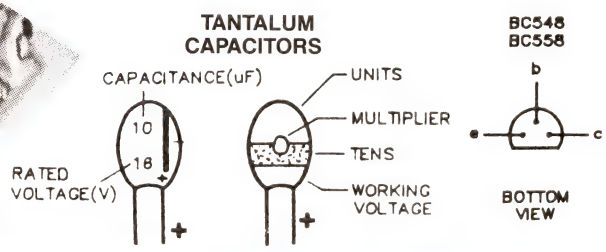
LM383T or LM383AT

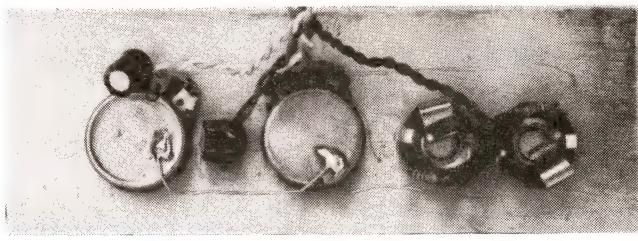




Full-size printed circuit artwork.







Here's the completed Practice Amp control panel, viewed from the rear. Note the linking of the two potentiometer cases with tinned copper wire.

each panel is a good idea. Fill the joints in the completed cabinet and touch-up with more paint for a really slick finish.

Tackle the control panel next. This is a piece of 20 gauge (or 1 mm) aluminium 154 x 55 mm. It is narrower than the edge in order to clear the corner pieces. You can use the control panel artwork here as a template to mark out the hole positions for the components that mount on it.

Use a centre punch or other sharp-pointed tool to mark the hole centres. Drill a 'pilot' hole, then a hole of the right size, or a hole just large enough to get a reamer in and then ream out the hole to the right diameter. Deburr the holes when you're finished, to leave smooth surfaces on the panel. The panel can be dressed up with a Scotchcal escutcheon, and we have reproduced artwork for it here.

The panel can be glued to the ledge, or screwed to it, in which case you'll need to drill a couple of holes, say one in the centre of each end. Countersunk-head screws may be used, so that they will be covered by the Scotchcal escutcheon.

Assembling the electronics

The electronics is quite straightforward. Most of the components are mounted on a small printed circuit board measuring about 60 x 45 mm. This board may be purchased ready-made, it may be supplied as part of a kit, or you can make your own.

If you're adventurous enough to make your own, use a set of pc board-making supplies from one of the electronics retail stores and carefully follow the instructions. Don't forget you'll need to drill the board once you've etched it, and you'll need the appropriate tools. Most of the component holes may be drilled with a 0.8 or 1.0 mm drill. Drill from the *copper* side. The vertical-type TO-220 heatsink has securing tabs on the bottom and the board needs to be drilled to size to accommodate these. You can drill clearance holes for mounting bolts or screws in any convenient positions. We put two adjacent to each corner of the side where the AEM6510" board number appears. These were drilled to clear 3 mm diameter screws.

No matter how you obtained your board, give it a thorough visual check before commencing to solder components in place. Check that all the holes are drilled and are the correct diameter. See that there are no broken tracks or tiny copper bridges" running between adjacent pads or from pads to adjacent tracks.

The assembly of the components to this board is shown in the accompanying component overlay diagram. Note that all

View of the Pug-Nose control panel, showing the Distortion and Volume controls, the Top Cut switch and the two 6.5 mm input jacks.

Rick gets a hand from his son, Adam, during final assembly of the Pug-Nose cabinet.

the components mount on the non-copper side of the board.

You'll find it easiest to mount the LM383T/TDA200 power amp IC and its heatsink first. The leads of the LM383T are pre-formed so that the IC will stand vertical, but you may find the TDA2002 leads are pre-formed so that the IC lays flat against the board. In this case, you will have to carefully bend the leads so that the IC body stands perpendicular to the board.

Before proceeding further, wipe a little thermal compound on the rear of the IC's metal tab, where it will face onto the heatsink, to improve heat conduction. Place the heatsink in position and solder the tabs. It is not *essential* to solder the heatsink tabs to the board, but this will provide some mechanical support. Then place the IC in position. The legs need not protrude too far through the board – just sufficient to solder them is all that's required. This assembly is clearly shown in the accompanying pictures.

Bolt the IC and heatsink together, placing a solder lug under the bolt head (see the overlay diagram) so that a connection may be made to the large ground track on the board. Now solder the legs of the IC. Run a short length of tinned copper wire from the solder lug to the nearby hole in the ground track and solder it it place.

Next, solder the transistor, Q1, in place making sure you get it the right way round, followed by the resistors and capacitors. Watch the orientation of the polarised capacitors, C1, C2, C5, C6 and C7. All the components should be seated right down on the printed circuit board, capacitors C9 and C10 in particular.

Note that resistors R1 and R2 and capacitor C3 are mounted off-board. All connections to the off-board components are made by running wires from pads located along one side of the board, as is seen from the wiring diagram. We recommend you solder-in "pc pins" or "stakes", or make suitable terminations from a short length of tinned copper wire with a small loop bent in one end, soldering the other end to the board.

Once the pc board assembly is finished, give it a thorough check. See that all the joints are well made and shiny. Reheat any suspect joints. Make sure there are no solder "bridges" between closely-spaced pads, especially around the IC pins.

Now assemble the pots, jacks and switch to the front panel. Take care when tightening their securing nuts that you don't marr the escutcheon. Make sure that RV2 is the "log" control – it will have either a "B" prefix or a "C" suffix to the "5K" value marking. Resistors R1 and R2 simply solder onto the appropriate lugs on the jack sockets and their free ends are then soldered together. Note that the pot cases are soldered together with a length of tinned ▷

Overall view inside the completed Pug-Nose, showing placement of the amp pc board and the rear of the control panel.

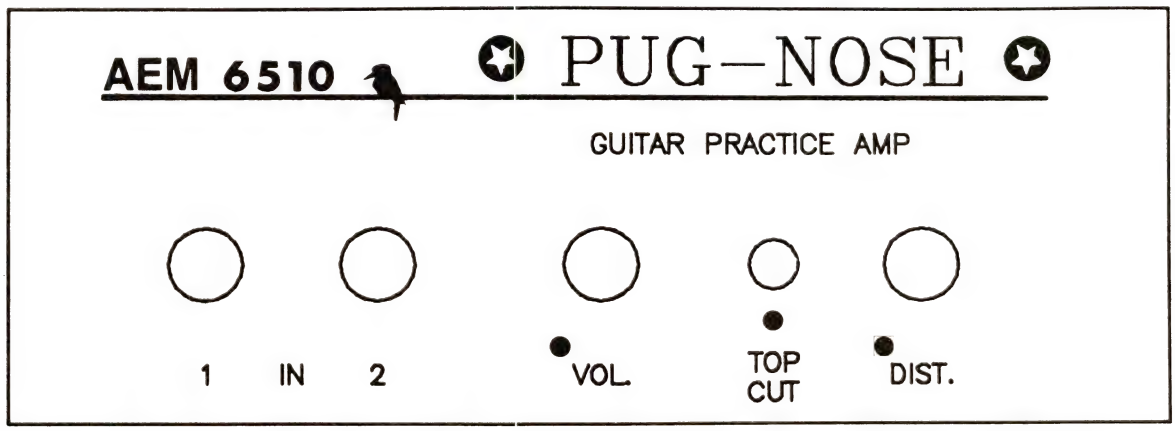
Rear view of the completed Pug-Nose. How the batteries are held in place depends very much on the type you use. They may simply be jammed in with a piece of styrofoam, or you could fashion a suitable bracket from a scrap piece of aluminium. You might also like to fit a rear panel, but we thought it was not essential.

copper wire that is extended to the common or "earth" lug on the input jacks. This subsequently goes to the board "earth" at pin B (the input earth point).

The wiring between the pc board and the components on the panel is done with tightly twisted hookup wire, with the exception of SW1, which is wired with ordinary screened cable. The length of these connections will depend on the distance between the control panel and where you mount the pc board. "Figure-8" cable was used to wire up the speaker and for the battery connection.

In our case, the board was mounted high on a side panel (see accompanying pictures), keeping the leads between the control panel and board quite short. Get an idea of the lengths required, leaving some slack, and cut your wires accordingly. Twist them tightly together then strip the ends and solder them in place with the panel and board lying adjacent on the bench. Watch you wire the pots correctly. Make sure you get C3 the right way round when you solder it onto RV1. The speaker gets wired up after you mount it all in the cabinet.

Control panel artwork, reproduced full size.



For the battery connection, we used alligator clips. What u use will depend on the battery or batteries you wish to e. This brings us to the question of on/off switching. The rcuit and wiring diagram shows switch jacks, wired so at the battery is off until you plug something into one of e inputs. This avoids accidental flattening of the batteries may happen if an on/off switch were accidentally left on. it yourself.

Incidentally, we haven't depicted actual switch jacks in e wiring diagram because types obtainable vary so much. u'll have to sort out their contact arrangements for urself.

At this stage it's a good idea to do a trial check. Set the top t off, the distortion and volume controls to minimum. mporarily hook up the speaker and battery (watch the polty!). Plug in an 'open' 6.5 mm plug (cover off). Touch your ger to the 'live' connection lug (the one that connects to e tip) and advance the volume control. You should hear m with the volume control advanced around half way. If t, remove the jack and check for a wiring or component acement error.

Check the temperature of IC1's heatsink. It should be only rm to touch, not *hot*. If it is, it's most likely that the IC's cillating at some frequency well outside the audio band. eck that the heatsink and IC tab is properly grounded via e link indicated on the overlay. All the IC's pins should be perly soldered in place. Note that C9 and C10 *MUST* be e ceramic type specified, else the amp will be unstable d liable to oscillate at some high frequency. See that C7's e right way round.

f, or when, all's well, plug in a guitar and advance the ume control while plucking a string. You should hear the nd come up clearly, without having to advance the ume all the way. Try advancing the distortion control. It uld boost the gain (and output level) as well as adding re distortion the more it's advanced. Try the top cut itch, too. It will "smooth out" the sound of the top ings.

Right, now you can mount it all in the cabinet. Undo the mporary speaker and battery hookup. Drop the pc board ough the slot in the ledge, then secure the control panel place. We screwed the pc board to a side panel, spacing it the surface with some small plastic spacers. Details on uring the batteries we'll have to leave to you as individual requirements will vary.

If you feel it warrants it, you can make a back for the cabinet. However, we didn't feel it was essential.

Your Pug-Nose is ready to rip!

The finished Pug-Nose Practice Amp is quite slick, as well as being wholly functional!

BATTERIES

The type of battery you choose will depend on just how you plan to use your Pug-Nose Practice Amp. Rechargeable sealed lead-acid batteries are ideal, even though the initial purchase price is relatively high. Dry batteries, such as a pair of 6 V lantern batteries, may also be used.

Sealed lead-acid types, often referred to as "gell cells", are readily available with a nominal 12 V terminal voltage in a wide variety of amp-hour capacities and sizes. You might look at the range produced by Power-Sonic in Sydney, or the range available through Dick Smith Electronics stores. Many electronics retailers carry a range of gell cells. A capacity in the range of 3.5-4.0 amp-hours would be adequate. Gell cells generally come with automotive-type spade lug connectors. An in-line 1 A fuse in the positive lead might be a good idea.

If you want reverse-polarity protection, connect a hefty power diode — such as a 1N5404 or 1N5408 — across the supply connections on the board, anode to negative, cathode to positive. This will virtually short the battery should you accidentally connect it in reverse (this is where the in-line fuse comes in handy).

If you're using dry batteries, because their internal impedance is higher than rechargeable types, you'll need to connect a 1000 µF/16 V electrolytic across the supply connections on the board to "smooth out" the battery voltage dip that occurs with big signal peaks which results in some "pumping" of the output.

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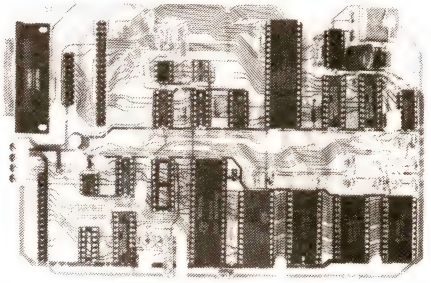
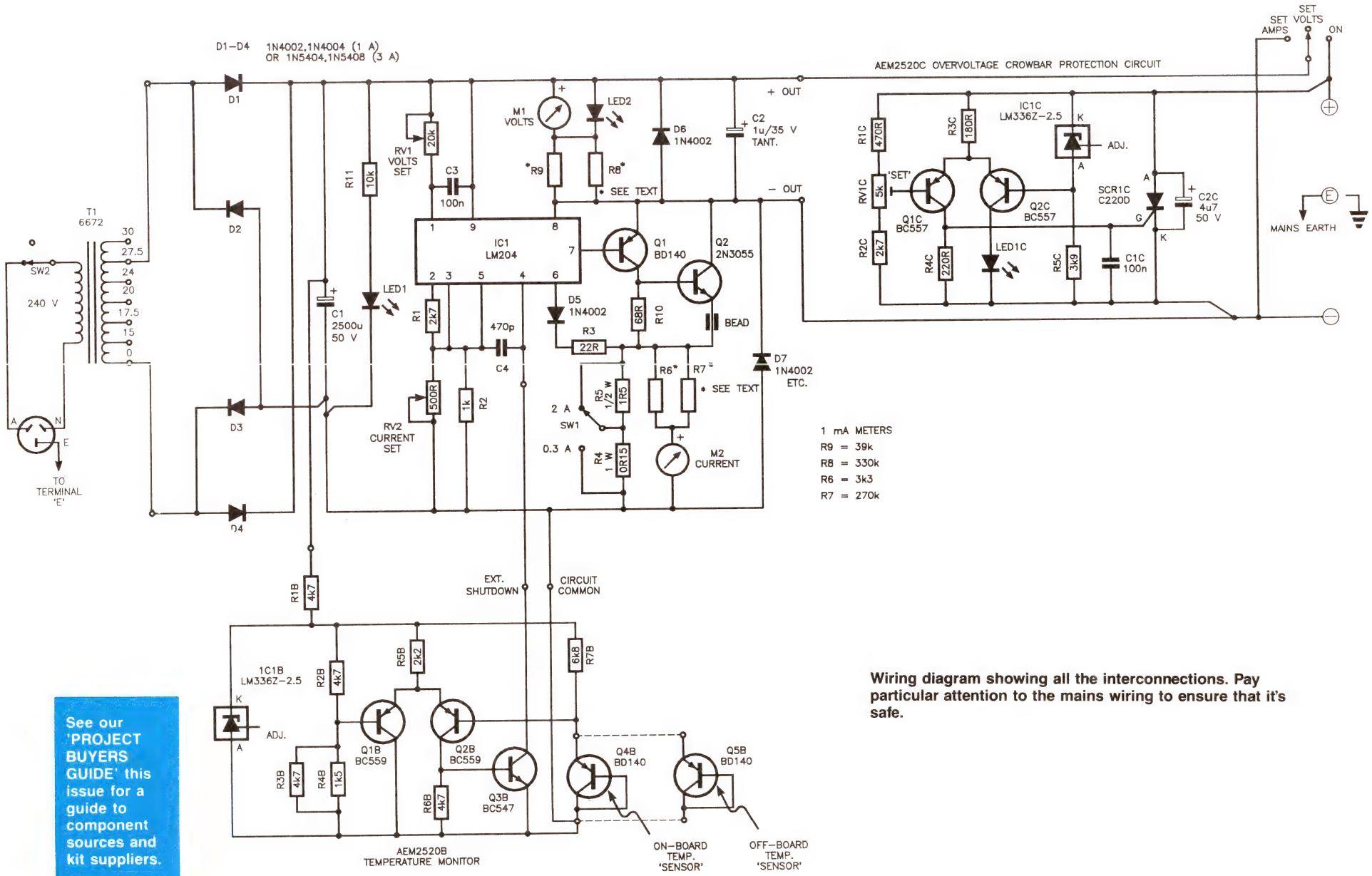


energy CONTROL Energy Control International Pty Ltd, 26 Boron St, Sumner Park Qld 4074. Phone (6107)376 2955. FAX (6107)376 3286. Telex AA43778. NZ Office: 104 Dixon St, Wellington 644858742



Wiring diagram showing all the interconnections. Pay particular attention to the mains wiring to ensure that it's safe.

See our 'PROJECT BUYERS GUIDE' this issue for a guide to component sources and kit suppliers.

Laboratory power supply based on the AEM2520 Versatile Power Supply module

SEE DEC 88-58.

Jonathon Scott
Brereton Samuel Research

Here the AEM2520 Versatile Power Supply module is employed as the heart of a lab-grade power supply featuring thermal overload and output crowbar protection with the addition of two small, low-cost add-on modules.

AS FORESHADOWED in my introductory article on *The Versatile Power Supply* in the July 1988 issue (page 35), this is the second project based on the AEM2520 VPS module. The first, also described in that issue, offered a number of attractive features which were used to good advantage in a low cost unit designed especially for the experimenter or the serviceman.

In this article two add-on modules are introduced which, together with the VPS circuit board, form a laboratory power supply of excellent specification. These two add-on projects are the AEM2520B Thermal Protection board and the AEM2520C Crowbar Protection unit. You will note that they are suitable for retro-fitting to an existing power supply.

This is part of the reason that they are introduced as separate items; I know that a lot of people already own or have built supplies which lack some facilities or complete protection. But, if you need an economical, fully protected, fully metered variable power supply offering good specifications, this project is for you.

FEATURES

0-30 V/2 A Output Capability
Variable Current Limit: 300 mA & 2 A
Dual Metering, Voltage & Current
Switched Output: Set Volts, Set Amps, On
Supply is "Floating" from Earth
Mains Operated
Over-temperature Shutdown
Presettable Over-voltage Crowbar Protection
Low Cost

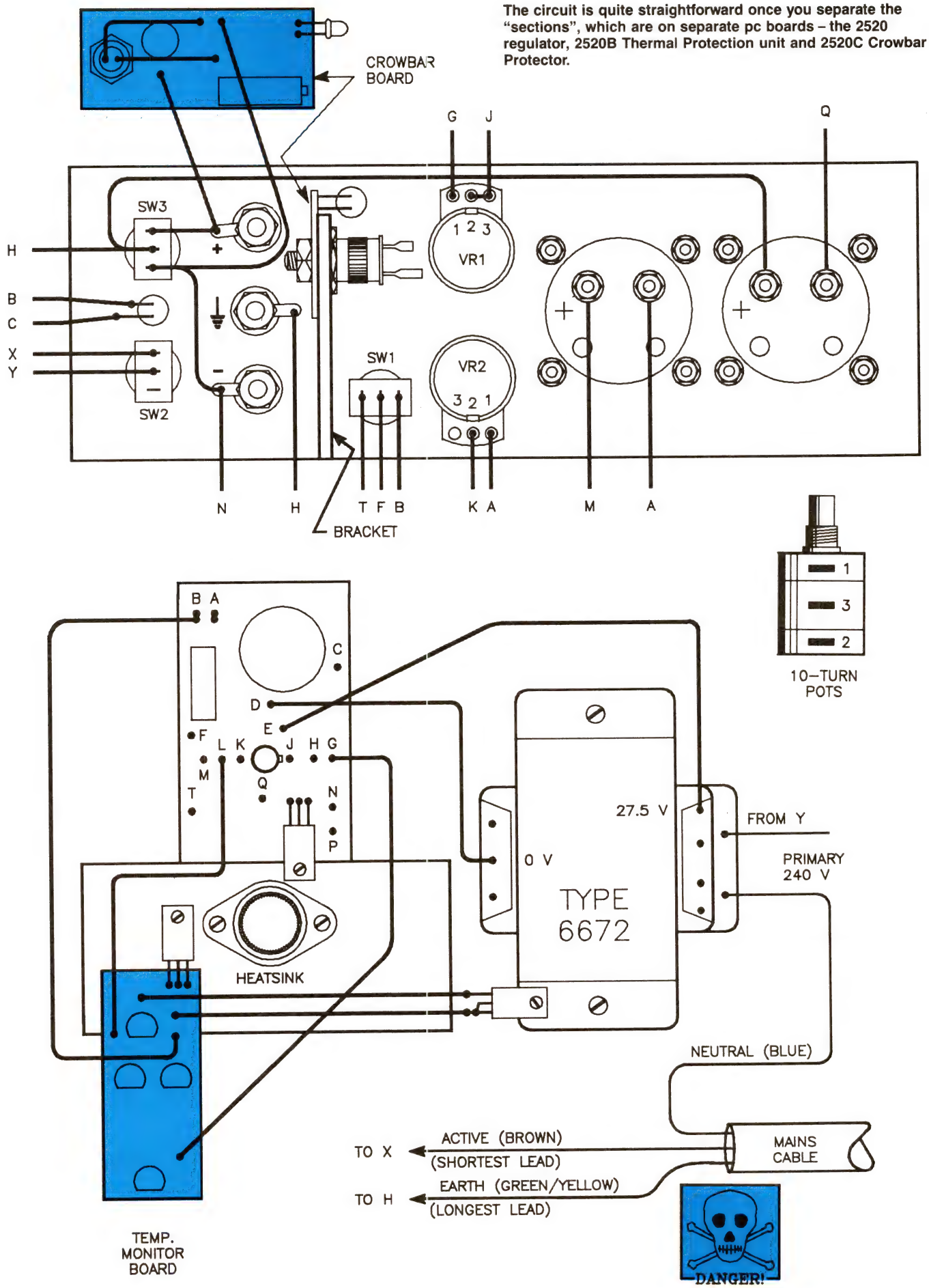
The Laboratory Supply

This supply has a number of differences to the previous one using the same regulator board.

- It is housed in an attractive instrument case;
- It has an internal mains transformer;
- It has the Crowbar and Thermal Protection facilities added;
- It has full metering.

In conjunction with the VPS circuit described previously, the Crowbar and Thermal Protection modules provide a pretty well "bulletproof" unit at an economical price. Basic output capability is 0-30 V/ 2 A, which is a ▷

The circuit is quite straightforward once you separate the "sections", which are on separate pc boards – the 2520 regulator, 2520B Thermal Protection unit and 2520C Crowbar Protector.



great improvement on the plague of 3-30 V/1 A supplies so often encountered, the limitations of which were discussed in the VPS article.

The cost of the supply is held low by the use of a '6672'-type transformer. This is a multi-tapped unit with outputs at 15, 17.5, 20, 24, 27.5 and 30 V, and a current rating of 1 A. The thing is, a supply such as this which is largely used for prototype testing and debugging, or for experimentation with circuits, is not often called on to deliver full current for long periods of time.

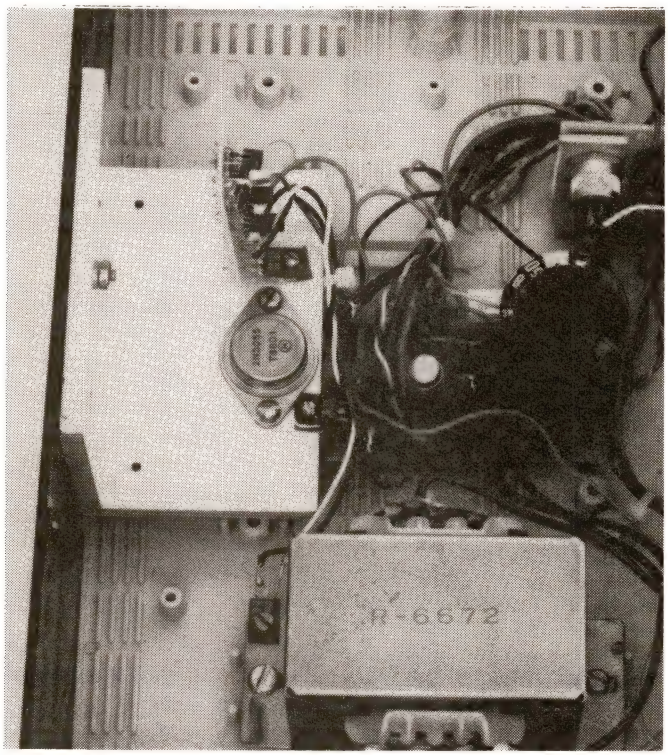
This supply can deliver about one amp (1.2 amps actually) continuously, and up to 35 V, but with 2 A (well, 2.3 A actually) capacity for durations of some minutes. Under full output conditions, the Thermal Protection module will shut down the regulator once the transformer or series-pass transistor heatsink rises above about 65°C or so.

Simultaneous metering of both output current and voltage is provided by two small, low-cost panel meters While "ST-38" types were used on the prototype shown in the photographs, "MU-45" types may equally well be used.

Ten-turn potentiometers were used for the output voltage and current limit controls as these allow much finer and easier setting of a desired output, particularly if you require an accurate value and use a digital multimeter to set the output. However, if their cost is not justifiable in your case (about $13-$15) these two controls may be common carbon pots, or wirewound types. The latter are around half the price of 10-turn pots, give a rather smoother action than carbon types, and guarantees that these controls will not get "scratchy" and hard to adjust in old age.

An output setting switch, SW3, has been included. This has a "centre zero, spring-return one way, toggle the other" action. In the centre position, the positive output terminal is isolated. The spring-return way (up) is used to short the output to enable setting of the current limit. Setting it the other way (down) switches the output on.

The matter of earthing is something to be considered here. It is very desirable to have the supply 'floating' – that is, no actual electrical connection to earth. I have taken the course of bringing the mains earth cord connection out to the front panel, to a green terminal between the output positive and negative terminals. When the supply is required to float free of the supply ground, this terminal can be left unconnected. Otherwise, it is best connected to one of the output terminals (*usually* the negative terminal, or the positive if the unit is employed as a negative-rail supply).



SPECIFICATIONS as measured on the prototype

Output Voltage:	0.015 V to 30 V (34 V max.)
Output Current:	Range 1 – 300 mA Range 2 – 2 A (2.3 A max.)
Load Regulation:	better than 0.01% at 100 mA load less than 40 mV from zero to 2 A
Output Ripple:	1 mV p-p at 500 mA load
Output Noise:	approx. 0.6 mVrms, dc – 100 kHz
Crowbar Protection:	4 V min, 40 V max.
Thermal Shutdown:	60-70 degrees Celsius, on series-pass heatsink and power transformer

A smart, low-cost plastic instrument case has been used to house the unit. It measures 260 mm wide by 190 mm deep and about 85 mm high and is the largest of the group of common "instrument" cases widely available through retailers. A Scotchcal escutcheon was used to dress-up the front panel, giving it a professional appearance.

Construction

With this project, it is best to commence by assembling the three printed circuit boards first. Construction of the AEM2520B Thermal Protection module and AEM2520C Crowbar Protection board are both described elsewhere in this issue.

Assembling the AEM2520 regulator board is fairly straightforward. In this instance, unlike the procedure with the previous project, leave Q1 and Q2 till last. Solder all the other semiconductors in first, taking care with their orientation, followed by the resistors and capacitors. Note that the metering circuit resistor R6, R7 and R9 are included in this project. Leave the large electrolytic, C1, until the end of this stage as it's bulky and makes handling the board a little difficult. Note that this capacitor may be mounted off the board if you wish, or if a pc-mount type (known as an "RB" capacitor) cannot be obtained. If such is the case, run heavy duty wires between it and the pc board to keep the ripple specification low.

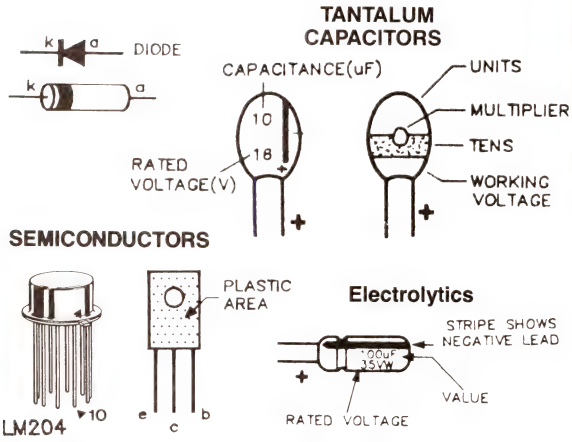
Use pc "pins" or "stakes" to provide ready connection for the leads that run to the other components and the add-on modules.

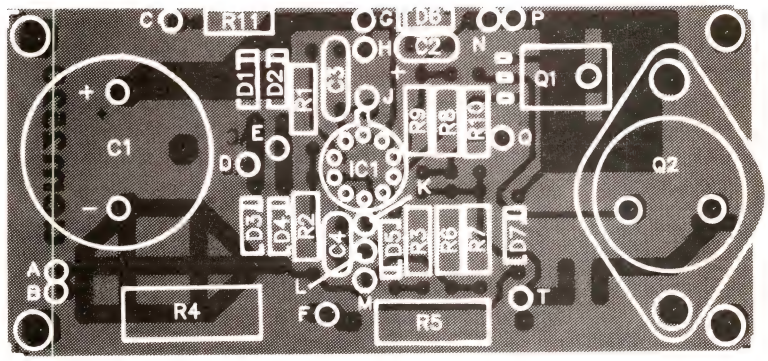
The regulator heatsink in this project is internally mounted and I have used a simple aluminium bracket about 100 mm long, cut from a piece of 50 x 50 x 5 mm angle. The actual heatsink area is not too critical here. As I have used the Thermal Protection module, if it is too small, the supply will just shut down at a slightly lower "strain" level.

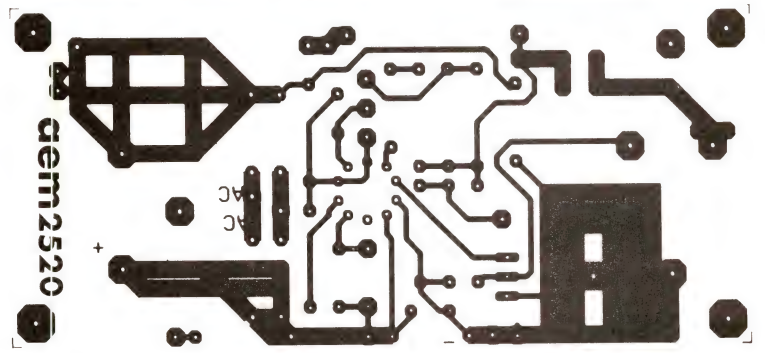
Mark out and drill the heatsink. The loaded pc board may be used to do this. Position the board centrally along the edge of one angle, as can be seen in the photographs. At the same time, locate a position to mount transistor Q4(B) of the Thermal Protection module and drill a hole. I positioned it to the right of Q2, the regulator series-pass transistor, as can be seen from the photographs.

Now mark out and drill holes to attach the heatsink to the rear or bottom of the case. Just how you attach it is not terribly critical. The temperature sensor system will not allow the heatsink to get so hot as to melt the case. The case comes with a plethora of spots designed to accept self-tapping screws, but if you prefer, you can hold it with plain nuts and bolts. I used a bolt to hold it to the rear ▷

Overlay diagram for the AEM2520 regulator board. The external connections are designated by letters which relate to those shown on the wiring diagram over the page.

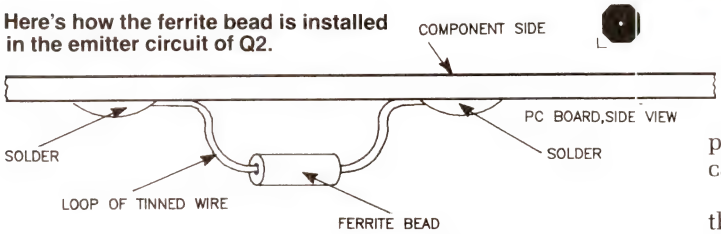






Full-size artwork for the 2520 pc board.

Here's how the ferrite bead is installed in the emitter circuit of Q2.



LEVEL: We rate this construction project as suitable for constructors of:

INTERMEDIATE

experience, between beginners and experienced constructors, with experience in building a number of projects of differing complexity.

PARTS LIST AEM2521

AEM2520 BOARD

Semiconductors:

Q1 ..... BD140, etc
Q2 ..... 2N3055
IC1 ..... LM204/304 (see text)
D1-D4 ..... 1N5404, 1N5408
LED1 .. 5 mm LED (any colour)

Resistors all ¼W, 5% unless noted

R1 ..... 2k7
R2 ..... 1k
R3 ..... 22R
R4 ..... 0R15, 1 W or 5 W
R5 ..... 1R5, 1/2 W
R6 .... 3k3, for 1 mA/50R meter
R7 ... 270R for 1 mA/50R meter
R8 ..... 39k for 1 mA/50R meter
R9 ... 330k for 1 mA/50R meter
R10 ..... 68R
R11 ..... 1k8 for normal LED
RV1 ..... 20k panel mount pot
RV2 ..... 500R panel mount pot

Capacitors

C1 ..... 2500u/50 V RB electro.
C2 ..... 1u/35 V tant.
C3 ..... 100n (0.1u) greencap
C4 ..... 470p ceramic

Miscellaneous

AEM2520 pc board; 16 pc pins or stakes; TO-126 transistor insulating set; heatsink (see text); ferrite bead (FX1115 or 35-032-28); short length of tinned copper wire; one plastic bolt and nut (if required) – 12 mm by 4BA; two 12 mm by 4BA metal bolts and nuts.

AEM2520B BOARD

See accompanying article.

AEM2520C BOARD

See accompanying article.

Additional hardware

M1, M2 .... 1 mA/50 Ohm panel meters, ST-38 or MU-45 types
SW1, SW2 ..... SPDT min. toggle switches
SW3 ... SPDT centre-off, spring-return one way, toggle the other

Mains transformer, 6672-type or similar 30 V/1 A type; mains cord clamp; mains plug and cable; Scotchcal panel escutcheon and meter scales; instrument case – 85 x 260 x 190 mm; two knobs; three 4 mm terminals; one LED mounting bezel; hookup wire – heavy duty and light duty; heatshrink tubing, tinned copper wire, solder lugs, extra nuts and bolts, self-tapping screws, etc.

Estimated cost: $105-$118

panel. Also drill a hole in the rear panel to take the mains cable clamp. *Always* deburr holes after drilling!

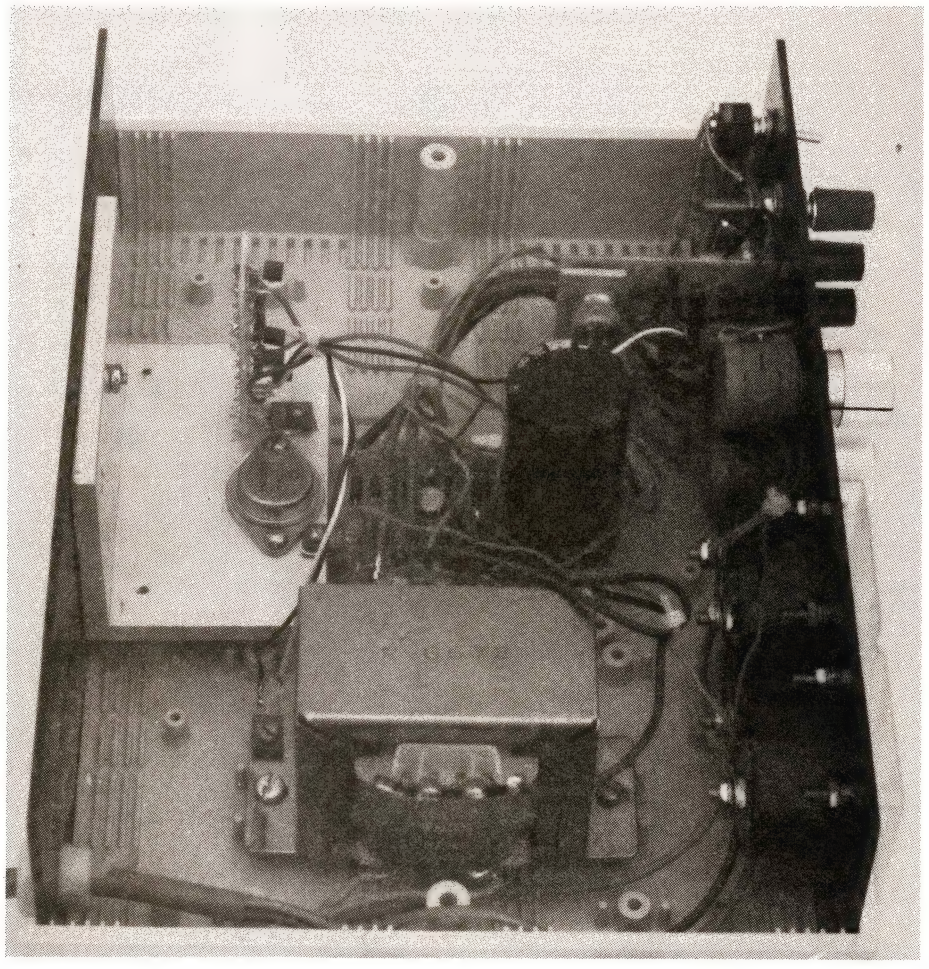
Now the regulator board, Q1 and Q2 may be assembled to the heatsink. Refer to the accompanying photographs. Bolt Q2 and the board in place first. Use thermal compound on the underside of Q2 and topside of the heatsink. Follow by mounting Q1. Note that it is insulated from the heatsink and goes metal side down. The metal face is connected to the collector. Smear thermal compound on the metal face of Q1 and on the heatsink where it will go. Preferably use a plastic bolt to secure it or, if using a metal one, use an insulating bushing to see that the metal face does not short to the heatsink via the bolt.

With the regulator board mounted on the heatsink, now you can install the ferrite bead in the emitter circuit of Q2, as shown in the accompanying drawing.

The AEM2520B Thermal Protection module may now be mounted to the heatsink. I mounted it vertically, as you can see; it holds its own weight when Q4(B) is attached to the main heatsink, and so requires no special mounting arrangements. However, it's a good idea to provide some mechanical support by applying something such as Silastic (silicone sealing compound) to the area around the legs of Q4(B) and where the board meets the heatsink.

The case's front panel can be tackled next. Exactly where you position the switches, meters and terminals etc, will depend on the hole sizes required by the particular components obtained. Kit purchasers may be fortunate to be supplied with a ready-drilled front panel. If you need to drill your own, then the front panel artwork reproduced here may be used as a template, or at least as a guide should your components differ from those used in the prototype. Take particular attention of the location of the access hole for the Crowbar preset pot. If you locate this board in a different position to that shown in the photographs of the prototype, you will need to mark out and drill an access hole to suit.

As the front panel is a relatively soft plastic, you may drill suitably-sized 'pilot' holes and then carefully enlarge them with a reamer. Always remove any 'dags' from holes once you've finished. Check hole sizes and positioning by



Overall internal view of the project, showing general placement of the components and pc boards. Note the positions of the Thermal Protection and Crowbar boards. The latter is secured with a small aluminium bracket, adjacent to the output terminals. The transistor "sensing" the transformer temperature can be clearly seen bolted to the left hand foot. For safety's sake all mains terminations should be sleeved with heatshrink tubing.

temporarily assembling the components to the panel. Any 'sins' may be corrected and hidden by the Scotchcal escutcheon!

With the front panel drilling complete, the Scotchcal escutcheon can be prepared and applied. Soak the Scotchcal in water for several minutes, peeling off the backing first and placing it in the container of water glue side uppermost. The glue is water soluble, and this softens it allowing you to move it around when positioning it.

Wet the front panel with a sponge just before applying the Scotchcal. Place the Scotchcal on the panel and smooth it down, carefully slipping it into precise position. Smooth out any bubbles with a wet sponge, wiping from the centre toward the edges. Let it dry, then carefully cut out the holes.

When the front panel has dried you can assemble the meters, switches, pots, terminals and etc. Take care when doing this that you don't scratch or marr the front panel. Fit the meter scales at this time, too. Reproductions of the new scales are printed here and you can take copies and stick them over the meter scales taking care to position them properly. Note that SW3 needs to be oriented so that the spring-return position is up.

Once the pc boards have been populated and the panels prepared, it is time to fit the transformer in place. In order to sense its temperature, the Thermal Protection board will require its off-board "sensor", Q5(B), to be bolted to the transformer body. The best way to do this is to drill an extra hole in the mounting foot. Ensure that the dags are removed, and connect the transistor with a little thermal compound to ensure that it is held at the same temperature as the transformer metalwork.

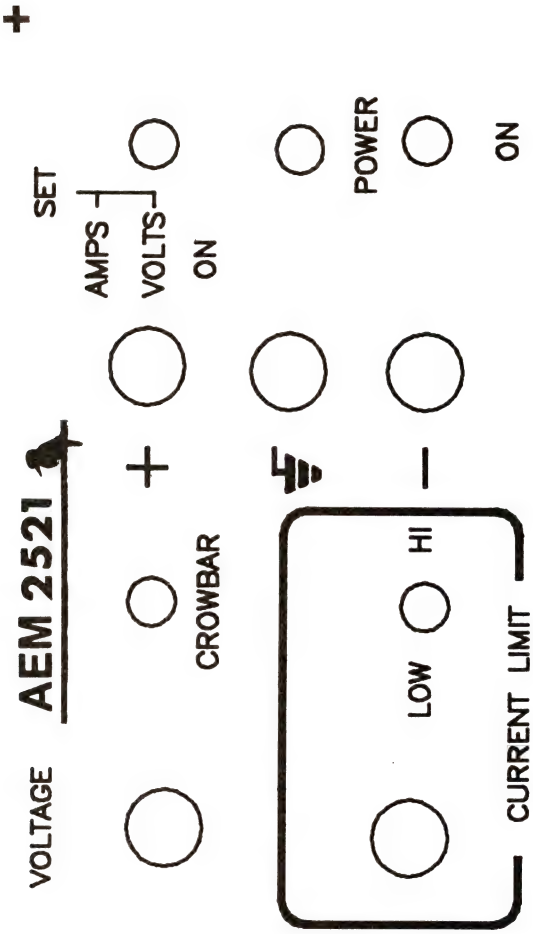
Mount the heatsink assembly to the rear panel and slot it into position in the case bottom. Lay the assembled panel near the front of the case bottom, panel bottom toward the case. The crowbar pc board is held in place behind the front panel with a small aluminium bracket screwed to the bottom of the case, as can be seen here. This bracket was made from a 15 mm wide scrap of 3 mm thick aluminium angle, 50 mm 'high' with a 20 mm 'foot'. It may be bent up from a scrap of 18 or 20 gauge aluminium 70 mm long.

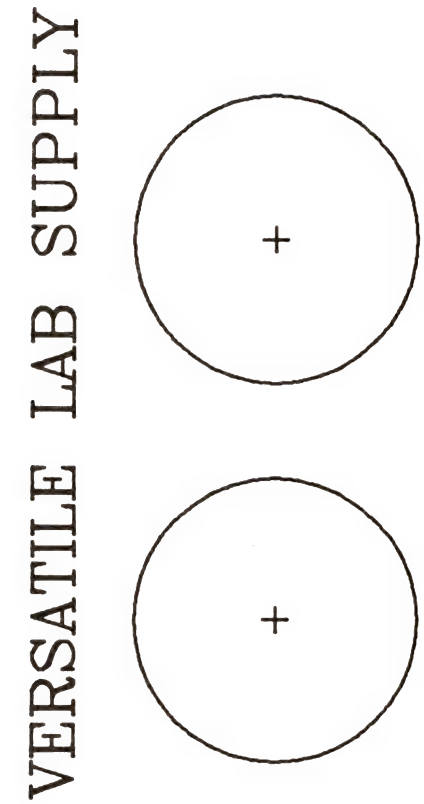
Now all the inter-wiring can be carried out. Examine the diagrams and photographs here and the panel and boards you have assembled to familiarise yourself with the location of each item.

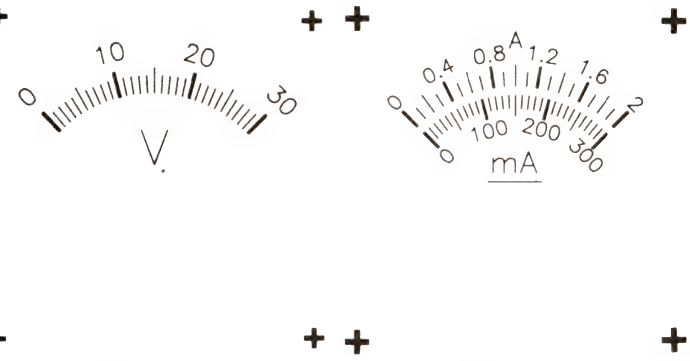
Tackle the wiring in a methodical manner, but it is wise to leave the mains cable till last. Follow the wiring diagram carefully, relating it to the circuit, too. You might check off all the connections of each item one by one, to ensure that there are none left unmade.

All current-carrying output connections must be run in heavy duty plastic insulated hookup wire (23 or 32 strand x 0.2 mm). This includes the connections from the regulator board output, around the output terminals and to SW1, those running from the transformer secondary to the ac input of the regulator board and the line from the mains switch (SW2) to the transformer primary. All the other wiring can be done in 10 x 0.2 mm plastic covered hookup wire. I "dressed" the wiring using plastic zip-tie cable clamps.

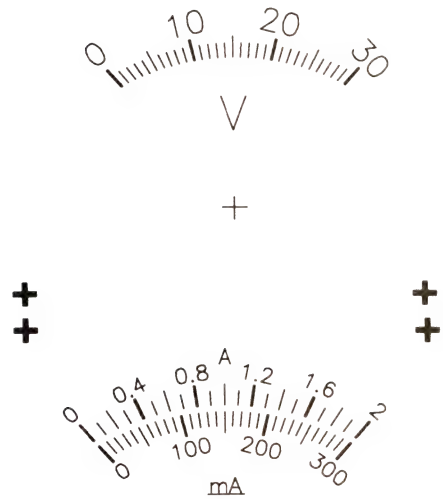
When fitting the mains cable, ensure that it is securely restrained. You should be able to *LIFT THE WHOLE SUPPLY* by the mains cable, rather like holding a rat by its tail, if the cord is adequately tethered. Also ensure that the active connection will break first, and the earth connection last, if the cord is pulled out. I did this simply by making the earth wire the longest of the three and the active wire the shortest, leaving it with the least slack. I also took the ▷







Meter scale artwork for ST-38 type meters.



Meter scale artwork for MU-45 type meters.

precaution of dressing the mains wires separately from those of the rest of the supply.

When wiring the mains on/off switch (SW2), for safety's sake, see that the mains active lead connects to the switch contact, NOT the pole. Otherwise, when this switch is thrown to the off position, the pole will connect the active to the unused contact, which is definitely an unsafe practise. Sleeve all the mains connections using heatshrink tubing to avoid accidental contact whenever the case is open.

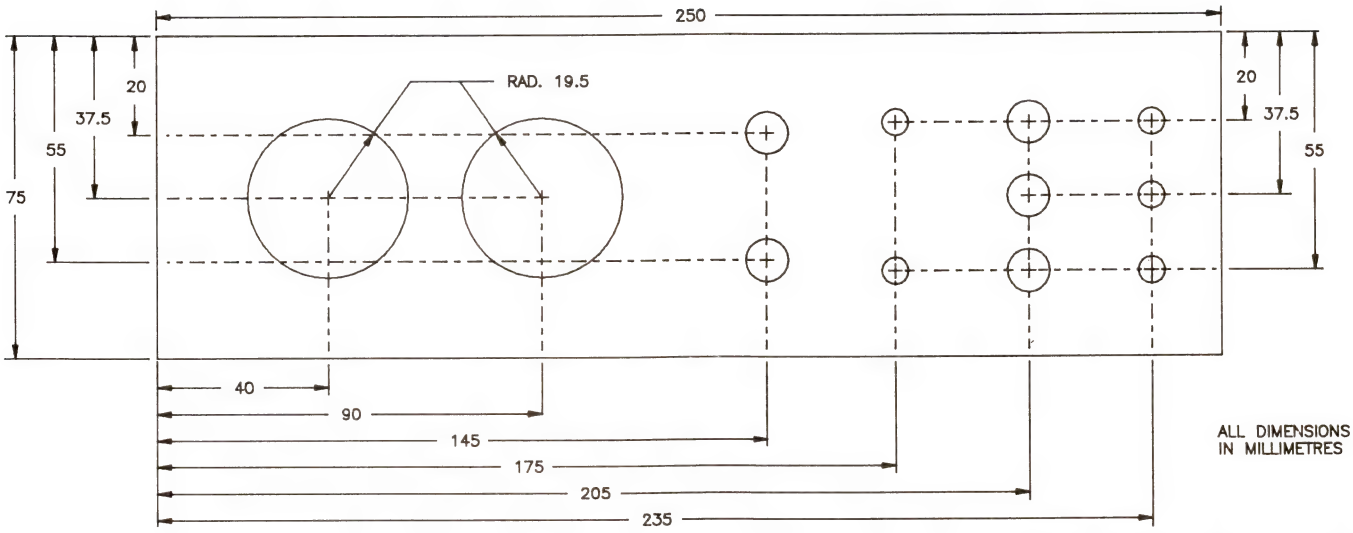
Once you have finished, *check everything*. Especially check the mains wiring. Use a multimeter set on the Ohms range or 'continuity check' to see that the mains on/off switch and is correctly wired. Correct any errors and you're ready to proceed checking it out.

Check out

Slot the front panel into the case bottom. Set SW3 to centre position and the current range switch (SW1) to the low current range and wind back the current limit control to almost zero; likewise with the voltage control. Set the Crowbar preset to maximum – this should be fully clockwise. Set the power switch to off.

Power up while watching the multimeter. *Keep your hands well away from the project, just in case there's a*

Full-size artwork for the AEM2521 front panel.



Drilling details for the front panel.

mains fault. If all is well, the meter reading should quickly rise to around 38-42 volts. If it's substantially different, quickly switch off, unplug the mains cord and look for a fault in the wiring or orientation of the rectifier diodes. Correct any faults and power up again.

If, or when, all's well advance the voltage control and see that the "volts" panel meter rises accordingly. Push SW3 to "SET AMPS" and see that the current panel meter rises slightly. Advance the current limit control and see that the current meter reading rises accordingly. If you do not get the correct indications at any stage here, switch off, unplug the project from the mains and look for a wiring or board assembly error. If either or both of the pots operate "backwards", reverse the connections to terminals 1 and 3.

While the unit's off, transfer the multimeter to the output terminals, then power up and see that the "volts" panel meter agrees with the output voltage read by the multimeter (set SW3 on!). Check the maximum output voltage, it should be around 33-35 V.

Set SW3 to the centre position ("set volts") and switch you multimeter to a high current range (2 A or more). Wind back the current limit control and set SW3 on. Wind up the current control and see that the current panel meter agrees with the multimeter reading.

Set SW3 off again, change SW1 to the high current range and wind back the current control pot. Set SW3 to on and again wind the current control up, checking that the panel meter agrees. Check the maximum output current, it should be around 2.2-2.3 amps – but don't take too long about it!

You can check the Crowbar board as follows. Wind back the current limit control about half way, set SW1 to the low current range and set SW3 on. Then, wind back the preset while watching the current meter. When you reach the trip point, the current meter will suddenly jump to the current you previously set.

You can check the Thermal Protection by advancing the current limit to 2 A and holding SW3 in the "SET AMPS" position for some minutes. The regulator will cut of the output current and the current meter reading will fall.

If you've got the gear – oscilloscope, dummy loads etc – you can check out the project's specifications.

When you're satisfied it's working properly, disconnect it from the mains and complete the case assembly. Your Versatile Lab Supply is ready for years of trusty service.

Variations

The resistor values given in the parts list for R6, R7, R8 and R9 are suitable for the widely available 1 mA meters with a resistance of 50 ohms. However, it is possible to use a meter with any current rating up to a few milliamps. The resistors are calculated as follows.

If the meter FSD current is I, and its internal resistance is R, and the desired full scale voltage display on the voltmeter is V, then the series resistance made up of R8 in parallel with R9, Rs say, is
found from:

$$Rs = V/I - R$$

The values of R8 and R9 are then found by choosing R8 as the first preferred value higher than Rs, and R9 as the closest preferred value to $1/(1/Rs - 1/R8)$.

It may be possible to obtain, or you may already have, meters with appropriate ranges. As an example, I built one prototype with a meter already calibrated for 30 volts full-scale deflection (fsd).

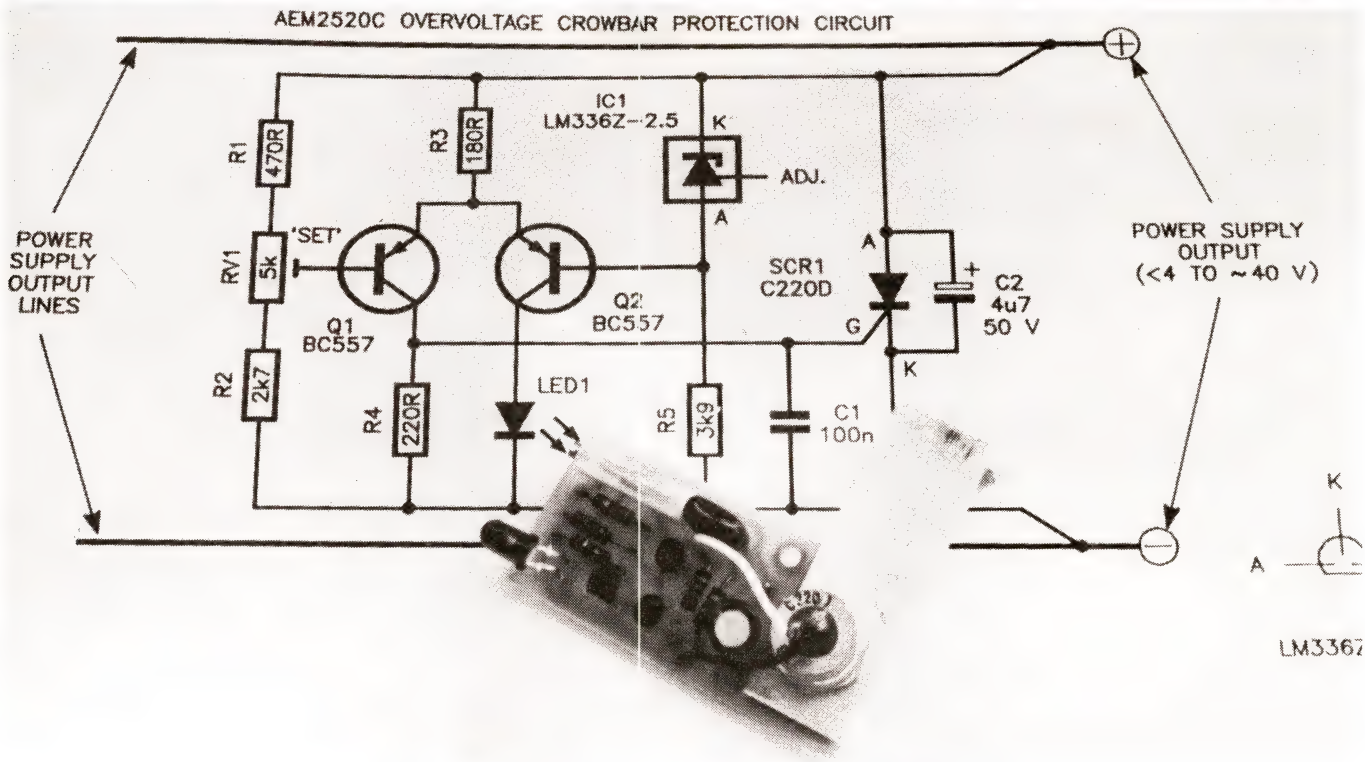
This approach has the advantage that the correct scale comes already affixed to the meter. In the case of the voltmeter, it is simply necessary to put zero Ohms in for R8. (This is what would come out of the equations above, once you measured the meter's internal resistance.) This cannot easily be done in the case of the ammeter, because it is associated with the range changing switch (SW1), and depends upon actually measuring the voltage across the switched resistors R4 and R5.

If you wish to add a current meter with a fixed range, it may be inserted in series with the wiper of SW1 but be aware that the range change switch will then alter only the limit range, not the meter range also.

If you have difficulty getting a 20k wirewound pot for the voltage control, it is possible to change the 'program' current through pins 1-2 of the LM204 on the regulator board to rescale the required pot resistance, say to 10k. This also affects the current control pot resistance.

Simply reduce R1 by a factor of two, and the required pot resistances will also decrease by a factor of two. Thus, using 1200 Ohms instead of 2700 will double (well, slightly more than double) the current through pins 1-2 of the LM204 and voltage per unit resistance in the two pots.

A fuse may be added in series with one of the leads from the transformer secondary to the regulator board (rectifier input) so that it blows when the Crowbar is tripped. This addition will protect anything you have connected to the output terminals should the regulator devices pack it in and apply the full rectifier voltage to the output. If you incorporate this fuse, mount a suitable fuse holder on the front panel, on the end opposite the mains cable inlet. Use a 3 A or 4 A fuse. Keep a supply of fuses handy.



"Crowbar" protection circuit for power supplies

Jonathon Scott
Brereton Samuel Research Pty Ltd

This simple project just connects across the output terminals of a power supply. It will sense when the voltage there exceeds a preset limit and apply an electronic short circuit (hence, "crowbar") to protect either the supply or the load according to the circumstances.

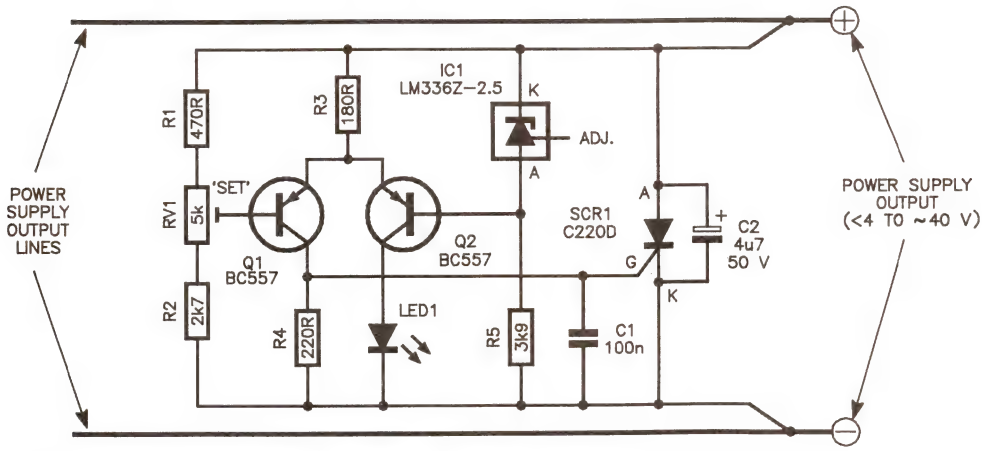
POWER SUPPLIES are very much taken for granted in electronics. They may be subjected to gross overloads from time to time, or have rechargeable batteries, in various states of charge, unceremoniously lumped across the output terminals, etc. If the battery voltage is higher than the supply's output voltage, the battery will drive current back into the supply with possible disasterous consequences. Under trying circumstances, the series-pass device or devices may fail, short circuit and apply the full, unregulated voltage to the output terminals. If you have a voltage sensitive load attached, this could spell disaster for it.

A crowbar circuit monitors a supply rail and applies an electronic short circuit if the voltage exceeds a preset level. In fixed equipment, a crowbar circuit is often incorporated to protect circuitry from the kind of failure which would otherwise expose it to excessive voltages, such as the short-circuit failure of the regulator.

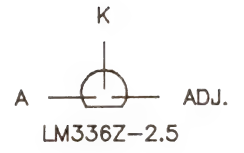
In a variable output labaratory or bench type supply, a crowbar is a circuit, usually preset by means of a screwdriver adjustment, which is adjusted to trip just above the desired supply output level, so that if there is either a failure, or more likely, a mistake, it electronically shorts the output terminals, invoking the supply's own limiting circuitry.

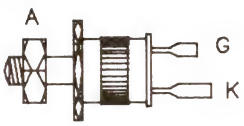
Should you connect a battery to the output whose terminal voltage is greater than the supply's output voltage (and thus the crowbar's trip voltage), then the crowbar will protect the supply.

The crowbar circuit presented here features an adjustable "trip" point that may be set at any level from 4 V to 40 V. The circuit requires no external supply rails, operating from the supply to which it is connected. When this exceeds the approximate 4 V minimum, it has enough supply voltage applied to operate and it lights a LED. When the level on the supply rails exceeds the preset trip voltage, the circuit fires an SCR which is connected across the rails, shutting off the LED and "clamping" the rail to something less than a volt. It is thus suitable for fitting to any power supply whose output (or maximum output) is less than 40 volts and which fuses or current limits at less than a few amps when overloaded.

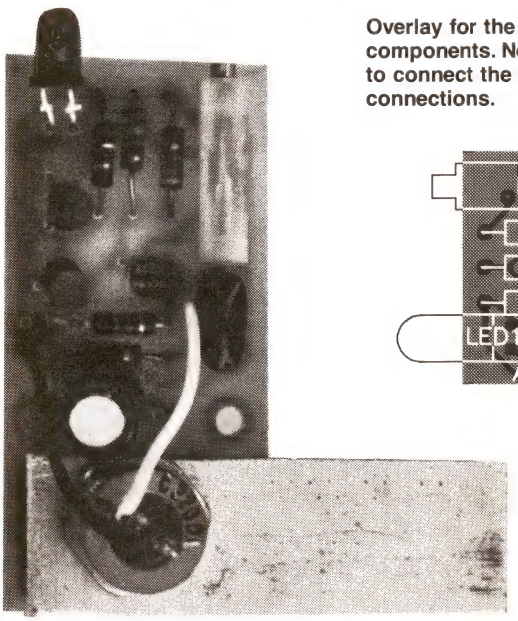


The circuit of the Crowbar is quite straightforward. The preset control RV1 sets the "trip" point voltage.



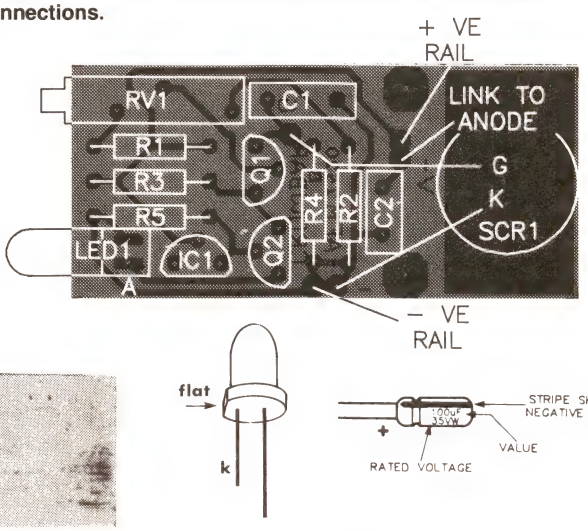


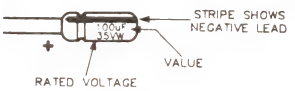
GE C220D



View of the completed Crowbar board. The SCR used here is the General Electric C220D stud-mount type. The bracket seen here is used to mount the board in our AEM2521 Versatile Lab. Supply.

Overlay for the Crowbar pc board, showing placement of the components. Note there's a link on the underside of the board to connect the SCR's anode in-circuit. Note the off-board connections.





PARTS LIST AEM2520C

Semiconductors

IC1 ..... LM336Z-2.5
LED1 ..... 5 mm green LED
Q1, Q2 ..... BC557
SCR1 ..... C164D, C168, C220D etc

Resistors all ¼W or ½W, 5%

R1 ..... 470R
R2 ..... 2k7
R3 ..... 180R
R4 ..... 220R
R5 ..... 3k9
RV1 ..... 5k, 10-turn or 20-turn trimpot

Capacitors

C1 ..... 100n poly
C2 ..... 4u7u/50 V RB electro.

Miscellaneous

Small heatsink or 20 mm length of 50 x 20 mm aluminium angle, AEM2520 pc board.

Estimated cost: $18 – $22

The project can be installed in an existing power supply, or dedicated inside equipment. Elsewhere in this issue, I describe how to use it in conjunction with the AEM2520 Versatile Power Supply module and the AEM2520B Temperature Monitor module, making up the AEM2521 Laboratory Supply.

Why not use an SCR instead of a relay? A relay will typically take 20 to 100 milliseconds to close its contacts, in which time any solid state devices affected will self-destruct. An SCR will operate in one-thousandth of that time, or less. In addition, relay contacts used to short circuit a dc source would have to be *very* hefty indeed.

The circuit

The crowbar circuit consists of a comparator, a voltage reference, and an SCR switch. The comparator trips the SCR into conduction if the incoming voltage exceeds a preset limit.

Transistors Q1 and Q2 form the comparator. If the base of Q1 falls to a potential below that on the base of Q2, Q1 is turned further on and eventually the SCR is turned on, conducting from anode to cathode and shorting the supply rail.

IC1, an LM336Z-2.5, provides a fixed reference of 2.49 volts less than the positive supply rail at the base of Q2. The base of Q1 is held at a fraction of the rail voltage to which the unit is connected. This fraction is preset by RV1, so that this control sets the trip voltage of the whole circuit. Thus the SCR will be tripped if the rail voltage causes the voltage on the base of Q1 to exceed the set limit.

When operating correctly, but at a level below the trip point, the major part of the current flowing into the comparator passes out of the collector of Q2, and through LED1, giving indication of satisfactory operation.

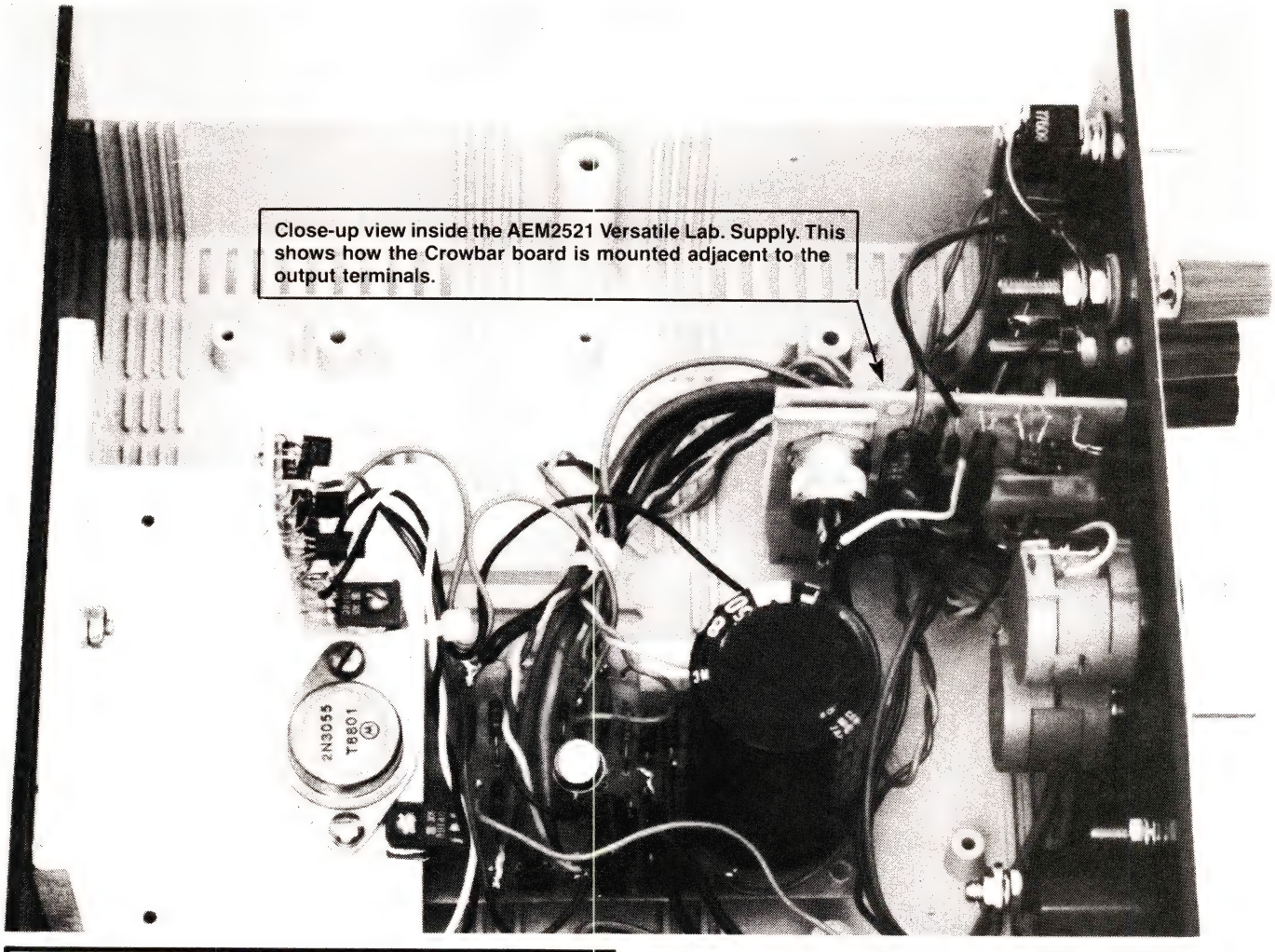
Capacitors C1 and C2 prevent spikes and sudden fluctuations tripping SCR1 accidentally. Resistors R1 and R2 set the limits between which the crowbar level can be set. The values chosen give range limits of about 3.5 volts minimum to over 40 volts maximum.

Construction

This project, like the companion Temperature Monitor module, has been designed to be simple to build and install, either in this project or as a retrofit to any existing supply.

The first step is to assemble the printed circuit board. Be sure to get the LED, the two transistors, the electrolytic capacitor and IC1 the right way around. Refer to the component overlay and component pinout diagrams.

Space has been made available on the board to mount a ▷



Close-up view inside the AEM2521 Versatile Lab. Supply. This shows how the Crowbar board is mounted adjacent to the output terminals.

LEVEL: We rate this construction project as suitable for constructors of:

INTERMEDIATE

experience, between beginners and experienced constructors, with experience in building a number of projects of differing complexity.

stud type SCR, but either a TO-220 flat plastic case type or the stud type can be used. I recommend using one with a large current rating, especially if you do not know what the supply surge capability is, and also because the crowbar may fire across an external source of excessive voltage and current capacity.

Imagine that you connect some rechargeable battery to the supply terminals after having used the crowbar to guard a 5 V circuit: The crowbar will trip, and something is going to fuse. It is much better if it is a piece of thin connecting cable rather than the SCR that passes on in a puff of glory. To this end, a hefty device rated at 16 to 35 A or so is a much better investment. The SCR's voltage rating is not critical as it will not be called on to withstand more than 40 V, so a 100 V device will do, but any device of greater rating will suffice equally as well.

In either case, the SCR and board should be bolted to a small bracket, both to mount the SCR and pc board and to provide a small amount of heatsinking. Really, no heatsink is needed if the supply to be protected is rated to limit at 2 A or less, and a stud type is used, but it cannot hurt, and something is needed to hold the weight of the circuit.

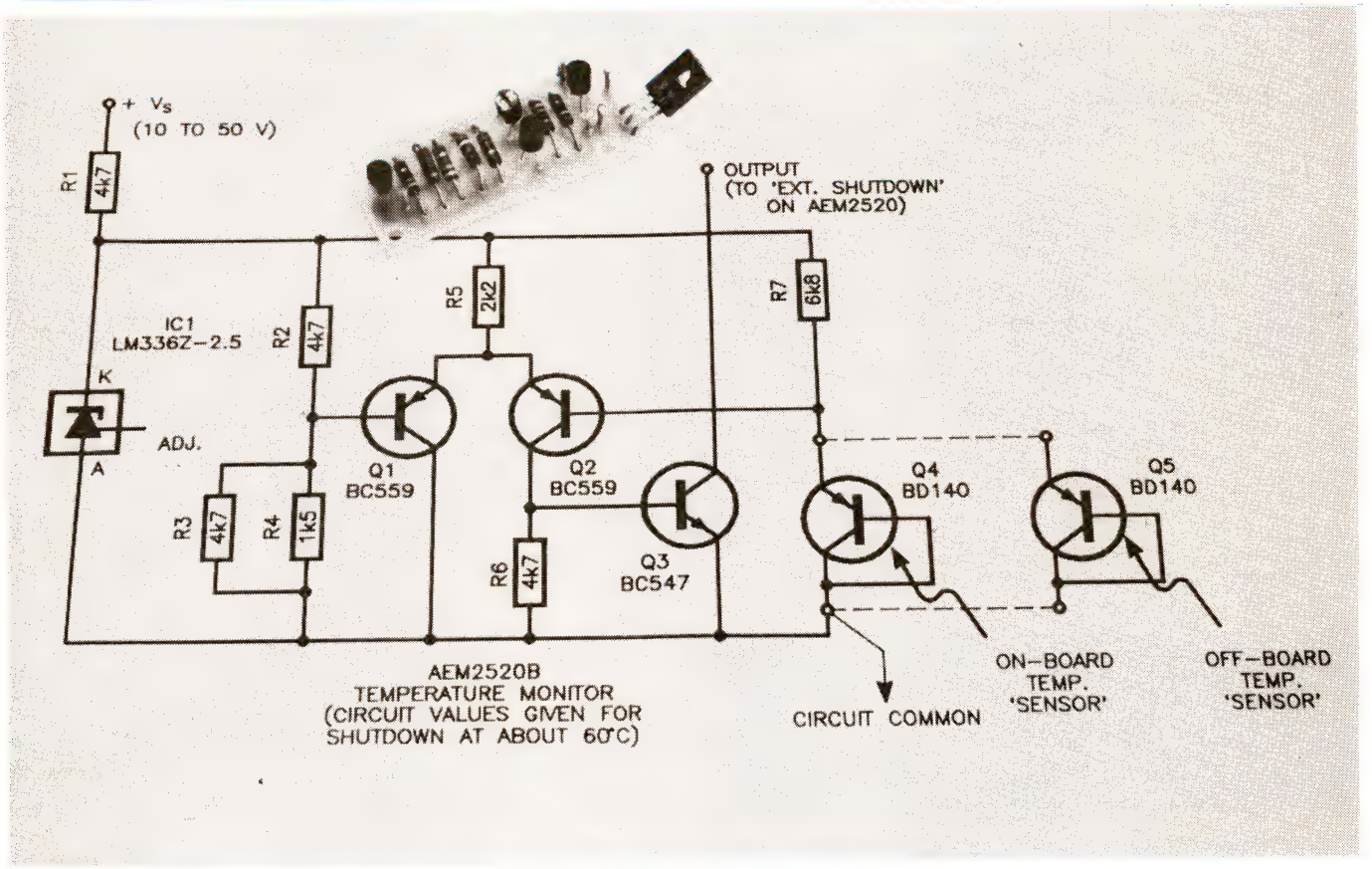
If the project circuit is to be mounted to a piece of metal connected to the circuit or the case, the SCR will have to be insulated from the bracket. Irrespective of whether it is insulated or not, thermal compound ought to be used between the bracket and the SCR.

Once the SCR is mounted, run some small flying leads to its anode, cathode and gate. Also attach two leads of heavy duty hookup wire to the positive and negative input pads. Once installed in the case of the supply, these will need to be run to the output of the main supply circuit. I recommend connecting these *directly* to the output terminals of the supply with the minimum possible lead length. This is all the electrical installation that is needed.

The only tricky part is locating the project so that the trip point adjustment pot is accessible for adjustment. When retro-fitting the project to an existing supply, this could be a nuisance, as there is not likely to be any panel room to spare. In this case, I recommend just mounting the board near a side panel and drilling a small pair of holes in the side or back.

There are a couple of other things you might consider when retro-fitting the crowbar to an existing supply, or when including it in a design under way. If the project is to protect the load on the supply from the possible collapse of the series regulator device, then you'll need a fuse in the positive supply rail somewhere so that the direct supply source is isolated should the crowbar be tripped. Such a fuse should be rated above the continuous current rating of the supply. So, for a 2 A rated supply, say, use a three or four amp fuse.

In use, you should keep an eye on the crowbar LED indicator when connecting a load to the supply output, especially if the load happens to be a rechargeable battery. If the LED goes out (you may get sparks anyway, depending on the load current), disconnect that load ASAP! If the load's a rechargeable battery, the connecting leads will likely "cook" very rapidly.



Thermal protection unit

Jonathon Scott Brereton Samuel Research Pty Ltd

Protect your power supply from heat stress! Install this simple thermal protection unit. While it has been designed to work in conjunction with our AEM2520 Versatile Power Supply Module, it can in fact be "retro-fitted" to other power supplies which incorporate an "active-low" shut-down, or any other equipment with a similar facility.

THIS SIMPLE PROJECT uses one or more transistors to sense the temperature of a heatsink, power transformer or whatever and to shut off the supply's regulator circuit to protect the unit in which it's installed.

Many supplies offer 'thermal protection'. This is usually built into a regulating IC, so that if the heatsink ceases to do its work, the supply shuts down peacefully, and restarts when cool.

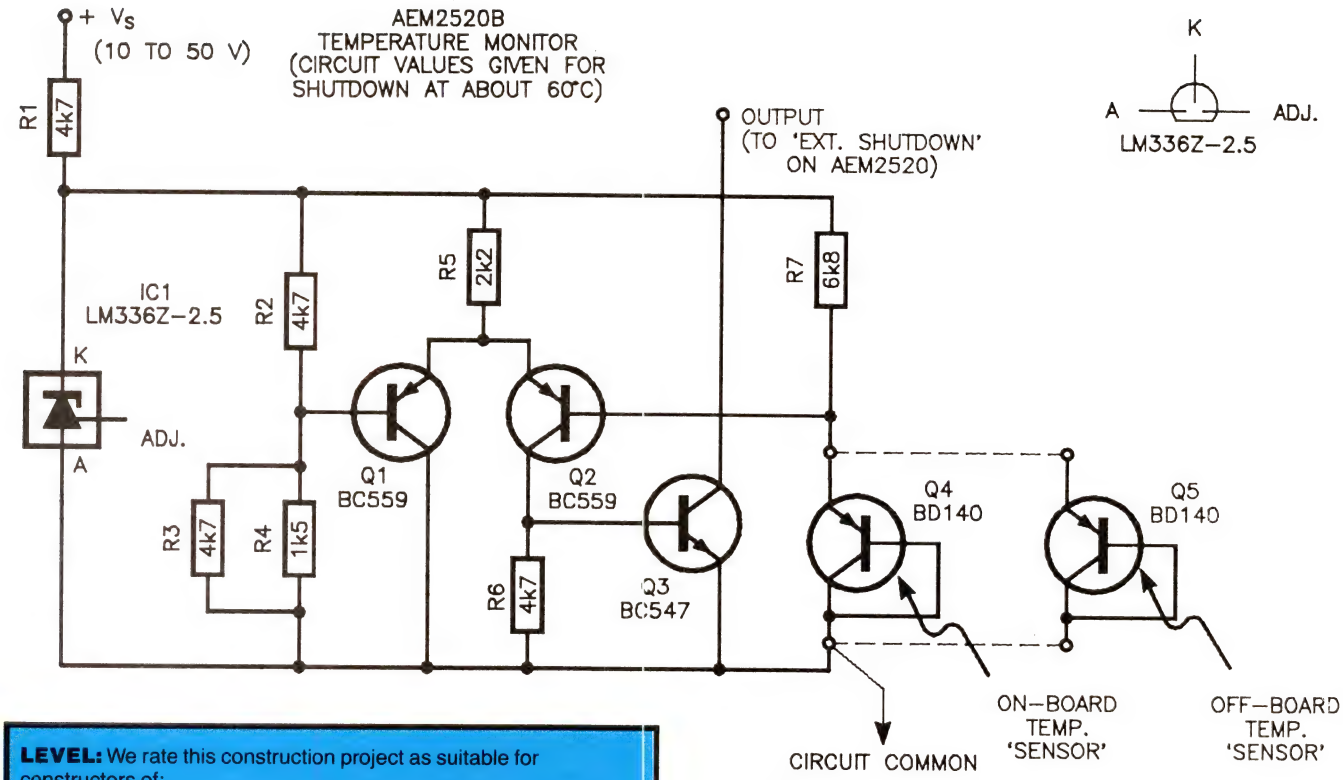
Now this idea is fine, but if a supply has adequate heatsinking, this sort of thing is not necessary. It comes into play if the heatsink comes adrift (when did this ever happen to you?) or if the heatsink is wrapped in a blanket or otherwise smothered so that it doesn't get adequate ventilation (not a common thing).

However, this sort of thermal shutdown is useless to any external pass transistor if it does not happen to be closely thermally connected to the regulator IC with the protection, and is quite incapable of detecting a roasting power transformer or an overheated rectifier etc, if such are a risk.

Are these risks significant? It turns out that they can be; indeed, it is desirable in one sense for them to be! Consider the demands made on a power supply. If it is rated to deliver two amps, it generally has to be able to deliver this indefinitely, and at every output level.

This means a transformer rated for two amps continuous operation and heatsinking enough to get rid of the heat from the series pass regulator associated with running this full load current into a short circuit or low voltage load. Think of the extra cost of the power transformer and heatsinks, which are rarely used at full rating – only, in fact, at these peak levels.

It is possible to overrate a transformer for a while without ▷



LEVEL: We rate this construction project as suitable for constructors of:

INTERMEDIATE

experience, between beginners and experienced constructors, with experience in building a number of projects of differing complexity.

The circuit is simplicity itself. The base-emitter junction voltage of a transistor (Q4) is used to "sense" the temperature of whatever it's bolted on to. Any number of additional off-board sensor devices are simply connected in parallel.

causing it any harm. It is also possible to dissipate much more heat than a heatsink can handle continuously, if it is for a brief period only.

A power supply can be designed to do this, but only if you have some guarantee, that is – protection, that the supply will not eventually expire. Such protection is conferred by thermal sensing linked to a shutdown mechanism, and that this extends to all affected parts of the supply.

The small protection circuit described here can have several separate temperature sensors, and will apply an *active-low* shutdown signal when any one exceeds a preset temperature. In this circuit the "shutdown" temperature is set to about 60-70 degrees, which is just a bit too hot to touch, but not too hot for the heatsink for a silicon device (pass transistor, regulator, rectifier, etc) or a power transformer.

How it works

The temperature monitor circuit consists of a precise voltage regulator and reference, a sensor array, and a small discrete comparator. The comparator turns on an open-collector transistor if the temperature of any sensor rises too high. The collector of this transistor can then be used to sink current from an "active-low" shutdown terminal on the circuit to be protected.

Referring to the temperature monitor circuit, IC1 is connected as a shunt regulator, and provides a very stable 2.49 volt supply for the rest of the circuit. IC1 is an LM336Z-2.5 which looks electronically like a very stable zener diode.

Power is derived from any external source ranging between 10 and 50 volts. The line marked "circuit common" goes to the negative (0 V) rail of the host unit's supply.

Resistors R2, R3 and R4 make a voltage divider which presents a constant level of 0.48 volts to one input of the comparator, as a reference. This voltage sets the temperature at which the circuit shuts down. This level results in a shutdown temperature of about 60 degrees Celcius with the components used in the sensor section.

Transistors Q1 and Q2 form a small comparator. Although these transistors are not matched, which would normally be required in a comparator, they provide quite adequate performance for this application. When the voltage on the base of Q2 falls below that on the base of Q1, Q2 turns further on and in turn switches Q3 on which pulls the output low, signalling a shutdown condition.

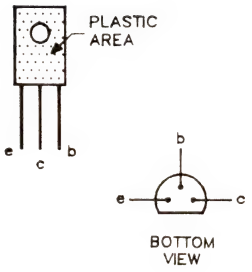
The temperature is simply sensed with a group of transistors, diode-connected and placed in parallel. The natural negative temperature coefficient of silicon junction transistors is then used to sense temperature: as the transistor gets hotter, its base-emitter voltage (Vbe) falls. BD140s are used, so that their collectors fall at earth potential (0 V rail) and need not be insulated from anything at this potential already.

The thermal runaway effect arising from the temperature coefficient ensures that the temperature "reported" (that is, activating the circuit) will be that of the hottest transistor, forming a natural OR gating action as required so that the monitor shuts down if *any* sensor reaches a temperature above the set shutdown point.

Assembling the unit

The monitor has been designed to be simple to build and install, either in this project, or as a retro-fit to any existing supply. It requires only that the supply have an active-low shutdown capability, TTL level compatible or similar, and a supply voltage of 10 to 50 volts available.

The first step is to solder all the components to the pc board. There are five semiconductors, which must be soldered in the right way around, and a number of unpolarised resistors which can go in any way round. I also recommend fitting some small pins to the pads from which wires will have to lead, so that installation is easier.



PARTS LIST AEM2520B

Semiconductors

IC1	LM336Z-2.5
Q1,Q2	BC559, BC179
Q3	BC547, BC107
Q4, Q5, etc	BD140

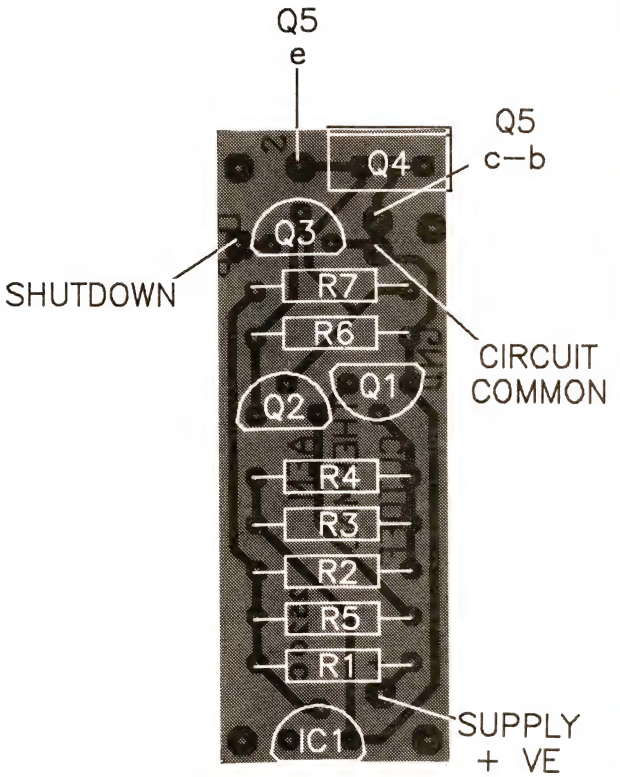
Resistors all ½W, 5%

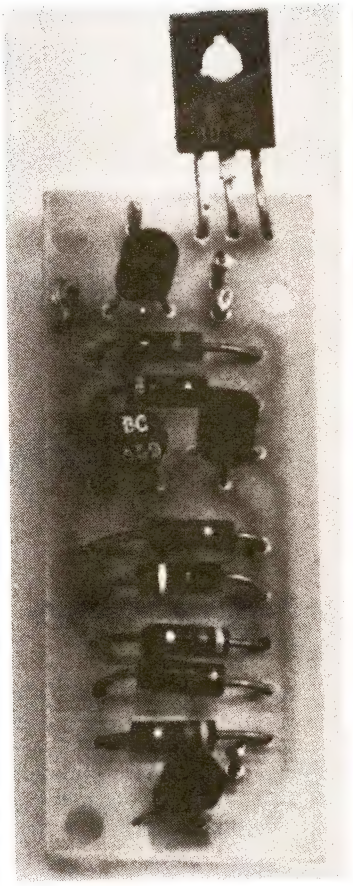
R1-R3	4k7
R4	1k5
R5	2k2
R6	4k7
R7	6k8

Miscellaneous

AEM2520B pc board; mounting nuts and bolts, thermal compound.

Estimated cost: $10 – $12





View of the completed Thermal Protection board. The TO-126 transistor hanging off the end serves as a temperature sensor. Additional such sensors may be mounted off-board and are connected in parallel.

The pc board carries Q4, a BD140 transistor used as one of the temperature sensors. The board is so small and light that it is easily mounted simply by bolting Q4 to whatever you wish to monitor, such as a heatsink. Thus, Q4 should be soldered in with enough lead length left such that it can be bolted to a flat surface and hold the board at right angles to the surface. It is recommended that some sealing compound, such as Silastic, be applied to this end of the board to provide some mechanical support. It should be spread generously around, covering the legs of Q4, too.

If the surface to which you wish to bolt Q4 is at the zero volts level, there is no need to insulate Q4 from it. This will often be the case, but is not the case with the AEM2520 VPS module if you wish to bolt the temperature sensor to the main heatsink as I have done (see the article on the AEM2521 Versatile Lab Supply also in this issue). In this case, you will have to use an insulating washer. In either case, you should use heatsink compound. as this ensures that as one heats up, so does the other.

Up to three more transistor temperature sensors can be connected in parallel with Q4, and provision is made on the printed circuit to run a twisted pair of wires off to these extra devices. All additional sensor transistors should be BD140s.

To install the monitor in a power supply, firstly choose a suitable place to fit it. This will normally be the main pass element's heatsink, and/or possibly the power transformer mounting hardware.

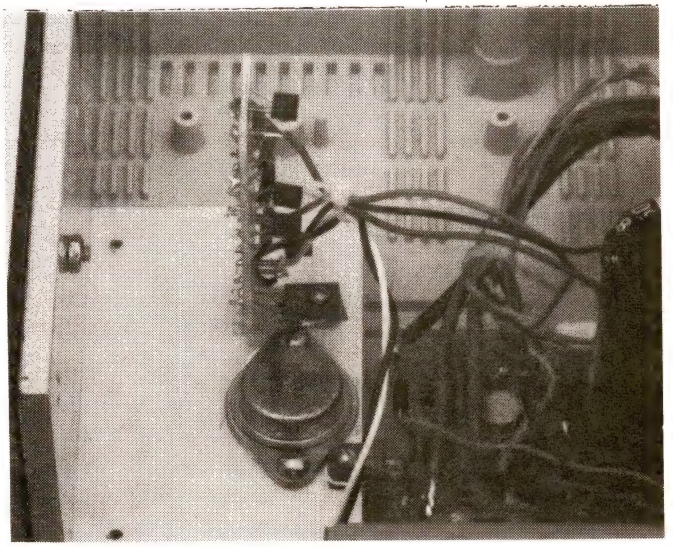
If you are in doubt as to what potential the item being temperature monitored is at, mount the sensor transistor(s) with an insulating washer. Take care to remove any metal dags and filings from mounting holes before applying thermal paste. The mounting bolt should be firm but not crushingly tight. Ensure that the printed circuit board does not foul any metal parts of the power supply case.

Once positioned, run wires to the positive and negative (unregulated) supplies, and to the external shutdown input of the supply. This completes the installation. I told you it was simple!

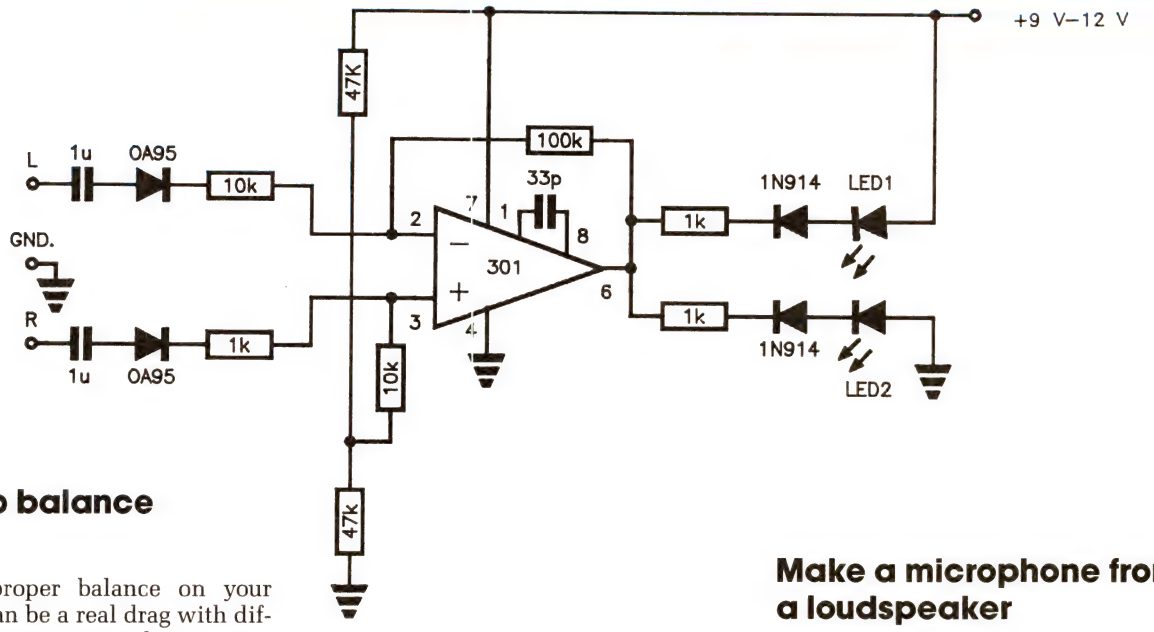
Changing the shutdown temperature

Should you wish to change the shutdown temperature, this can be achieved by using a different value for resistor R3.

Increasing it to 6k8 or 8k2 will cause shutdown at a temperature around 10 degrees lower, and reducing it to 3k9 or 3k3 will cause it to allow the circuitry to get *roaring hot* before it shuts down. I do not recommend the latter unless you are sure that it is not letting the supply, or whatever it's attached to, get warm enough first.



The Thermal Protection board is simply mounted by bolting down Q4 to whatever you want monitored, as seen here. Note that the transistor and board may be separated if space does not permit this arrangement. This shows how the project was used in the AEM2521 Versatile Power Supply.



LED stereo balance indicator

Setting the proper balance on your stereo setup can be a real drag with differing programme material. It's particularly a problem with broadcast material received on a tuner, I've noticed, often affecting "live" concerts. This circuit gives quite a sensitive indication of dynamic balance using two LEDs mounted together side-by-side.

The eye is quite sensitive to small differences in brightness between two closely-adjacent sources, which this circuit exploits.

Outputs from the left and right speaker terminals are fed to the L and R inputs, respectively. These are rectified by the OA95s, the resultant dc being fed, differentially, to the inverting and non-inverting inputs of the LM301 op-amp. The output of the 301 is biased to half the supply rail because the non-inverting input is biased at half the supply rail from the two 47k resistors which act as a voltage divider. The two LEDs will be evenly lit.

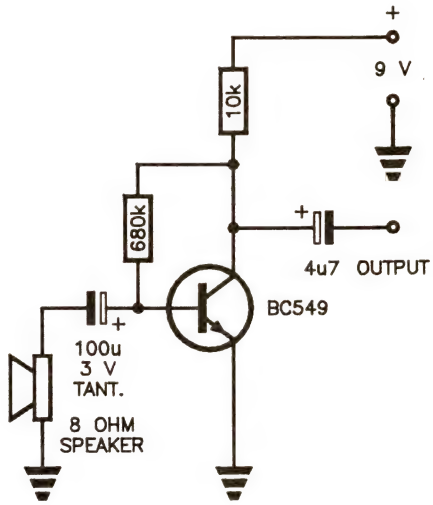
If the balance favours the left channel, there will be more dc on the inverting input of the 301 and its output swings toward ground, pulling more current through LED1 and reducing the current through LED2. Conversely, if the balance favours the right channel, there will be more dc on the non-inverting input of the 301, its output will swing towards the positive supply rail and more current will flow through LED2, less through LED1.

The 33 pF capacitor between pins 1 and 8 of the 301 provides frequency compensation. Feedback gives the 301 some gain. High efficiency LEDs work extremely well with this, especially if you can get either the rectangular or the square type, so they may be mounted directly against each other.

R. Hempel,
South Yarra, Vic.

Make a microphone from a loudspeaker

Any loudspeaker can be used as a microphone quite successfully, using this little circuit.



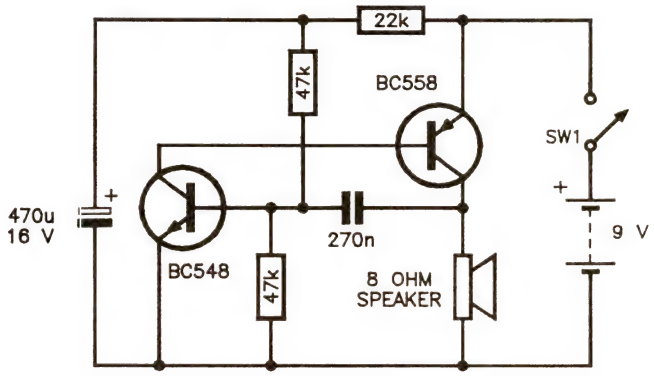
Air raid siren

This great little circuit produces a loud, realistic "air raid" siren sound from only a handful of components, and can be run from a 9 V battery, although a 6 V battery will do, too.

The siren's basic pitch is determined by the 270n capacitor. Change it to change the siren's pitch range. The "wail" is controlled by the 470 uF electrolytic capacitor. Increasing it slows the wail.

Note that, while an 8 Ohm speaker is shown, a 4 Ohm or 16 Ohm speaker will also work.

R. Lester,
St. Lucia, Qld.



A loudspeaker comprises a diaphragm (the cone) with a coil at its centre suspended in a magnetic field. Apply a voltage to the coil and the cone moves. Move the cone and the coil generates a voltage. Simple. However, loudspeakers are inherently low impedance devices and, as a microphone, they generate very low voltages. In general, the larger diameter speakers are more sensitive, having relatively greater output than the smaller speakers (especially the 50 mm "transistor radio" types!).

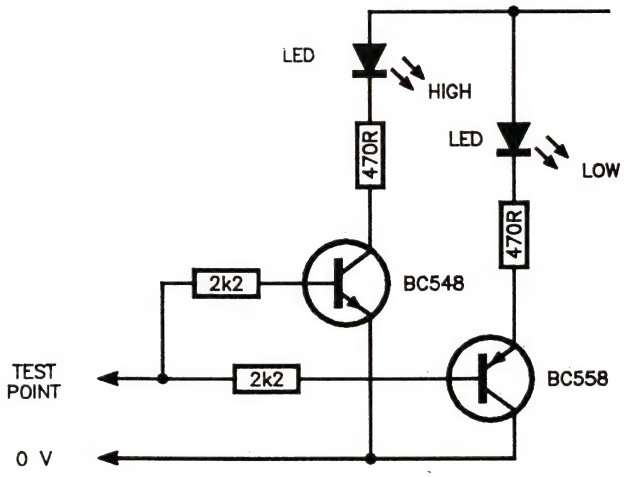
This circuit amplifies the speaker's very small output voltage, raising the level sufficiently to drive most amplifier inputs. The speaker is capacitively coupled to the base of the BC549 so that the transistor's base bias doesn't "bias" the speaker by running current through the coil, which reduces its sensitivity. The quality of the sound obtained depends on the speaker used.

L. Wasinski,
East Brighton, Vic.

Tacho for magneto-fired engines

With standard internal combustion engines using the Kettering spark coil ignition system, the points provide a pick-off point for pulses related directly to engine speed. But not so with a magneto-fired engine.

This circuit shows how you can pick off pulses from a magneto in order to electronically measure engine revs. The circuit uses the National Semiconductor LM2917 frequency-to-voltage converter, popularly used in many electronic tachos. It has the advantage of being rugged, able to accept widely varying input waveforms and drive a standard milliammeter with a linear scale.



The problem is picking-off the input pulses. I found this scheme worked quite well. An ordinary two-hole "TV" balun core, readily available through most electronics retail stores quite cheaply, can be used as a coupling transformer. It also provides good isolation. Keep the wires through the core holes away from each other. The lead from the 5-turn pickup coil can simply be figure-8 flex. The balun "pickup transformer" can be mounted conveniently near the magneto wiring.

There's nothing magic about the LM2917 circuit, this comes straight out of the application literature. The 2917 comes in several packages, the pinout shown here being for the 8-pin package. You can calibrate it using an audio oscillator or pulse generator connected to pins 1 and 8 of the 2917. All you need is a few volts of signal.

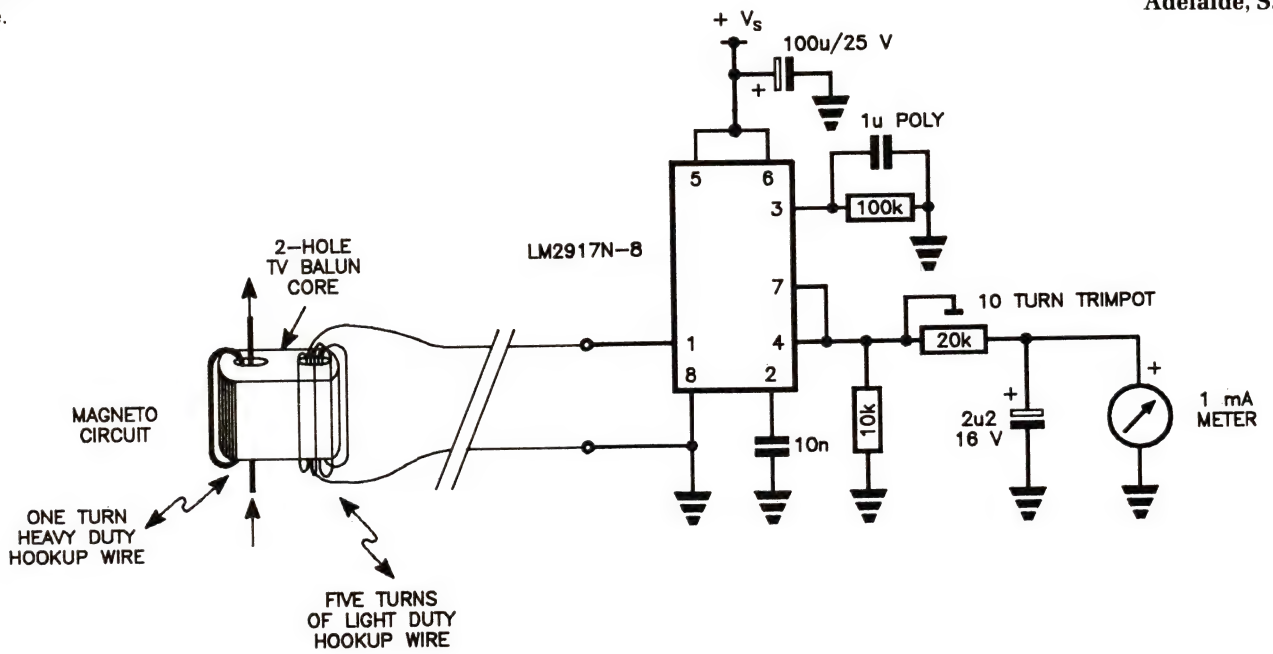
Charles Ray,
Hornsby, NSW.

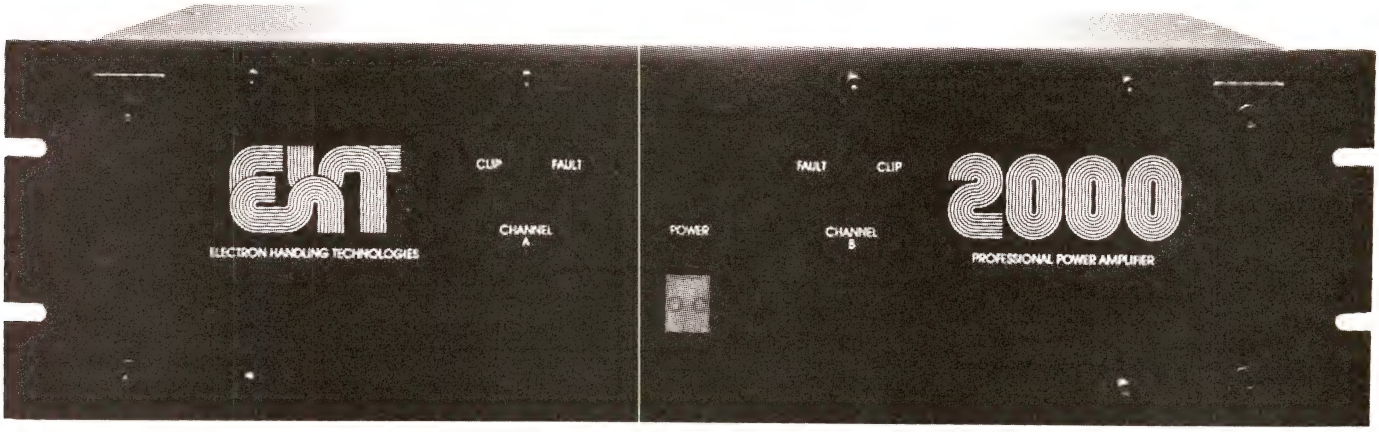
Simple logic checker

Boy, how simple can you get? This logic checker can be fitted in a pen barrel with a bit of judicious juggling. The LED anode return at the top of the circuit simply clips to the circuit-under-test's positive supply rail via a flying lead, the 0 V line to the ground or common, and the "test point" (which is best made from a prod of some sort), connected to the point to be checked.

If the point is at logic high, the "high" LED will light because the BC548 will be biased on and collector-emitter current will flow via the LED. The other LED will be off as the BC558 will be biased off. If the point being tested is at logic low, the BC558 will be biased on and collector-emitter current will flow, its LED lighting. The first LED will be off because the BC548 will now be biased off. Standard or high brightness LEDs may be used.

B. Johnson,
Adelaide, S.A.





PA power amp requirements

Mike Davis

Some practical advice on things you really need to consider when choosing and using professional PA amps.

TAKE YOUR AVERAGE power amplifier, cram it into a rack console with four or five similar units, drop it down the stairs, stick it in the back of a truck and drive over a dirt road for a few hours. Then, upon arrival at your destination, unload it (taking great care to drop it onto the concrete) and pour a can of beer over it. Stick it into a draughtless corner on a hot night, fill up the room with people and close all the doors and windows.

Wind up the music and drive the amp had into clipping for a few hours into half its rated load impedance and have some kind soul tug viciously on all the connecting cables. Now, just to add to the torment, insult and injury, short the outputs a few times and just for good measure, wind the mains up to 265 volts or so and run a CB transmitter in close proximity whilst periodically removing and inserting the mains plug.

Now, with all that, if it doesn't pour out wall-shattering bass and blistering treble night-in, night-out for at least a few years without breaking down, then it ain't no professional PA amp! Oh, and by the way, it had better not be too heavy and it would be really nice if it was small so that we can cram as many as possible in the truck. Whadidya say? 500 watts per channel? We need more than *that!*

The Electron Handling Technologies (EHT) PA amp above delivers 1 kW/ch is a rugged, locally designed and manufactured unit, featuring MOSFET output devices, clipping and fault indicators and hi-fi performance. Sold by Etone, (02)534 3569.

It should become rapidly obvious that we are not talking about your average ultra-high power domestic hi-fi amp. Such a unit would stomach maybe a night or so of this treatment and promptly expire in a tragic way; that is, if it hasn't already fallen to bits.

The roadie's view

An amp has to be carried and must, therefore, have handles. The handles are a stinker if they cut into your fingers while you are dropping it into a rack or road case, especially if it's a heavy amp. And the knobs shouldn't stick out, otherwise you can break them off too easily.

When you have to set up a 20 kW system a few nights a week, you quickly develop a hate for anything that is too heavy or cumbersome. And, let's get real here, of course it's gonna be dropped occasionally. the connectors have to be good, otherwise when you trip over a cable, you wrench the whole thing apart.

The "perfect" amp for me would:

- weigh nothing,
- pack about 1 kW per side,
- fit in a one-rack unit case, and
- never break down.

There's nothing worse than when the thing stuffs up in the middle of your smoko!

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WE ALSO MANUFACTURE A RANGE OF MOSFET POWER AMPLIFIERS
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The sound operator's view

First things first: reliability is the main requirement. When the amp's set up it has gotta keep pumping no matter what. Overheating is a real curse, because most amps just shut off. It gives you a real bad feeling when, suddenly, the amp for the bass speakers packs it in, all the bottom end bundies off and you're left with only your top end.

Most people keep on dancing anyway, but it is obvious there is a problem; and then you have to leave your mixing desk to fix it only to return and find some goon pouring beer into your sliders.

The amp shouldn't get hassled with compressed material, either, and it should have its own subsonic and supersonic filters. Basically, it's got to be:

- reliable,
- loud,
- clean,
- easy to drive, and
- not fart or splutter when you crank it up.

If your system has no automatic compressor, then you need clipping indicators on your amp. A lot of amps will destroy your top end (high frequency) drivers when run hard into clipping and without any subsonic filter, you run the risk or wearing out your bass drivers with useless rumble. You don't need *any* response below about 50-60 Hz; definitely none below 40 Hz. it's all a waste.

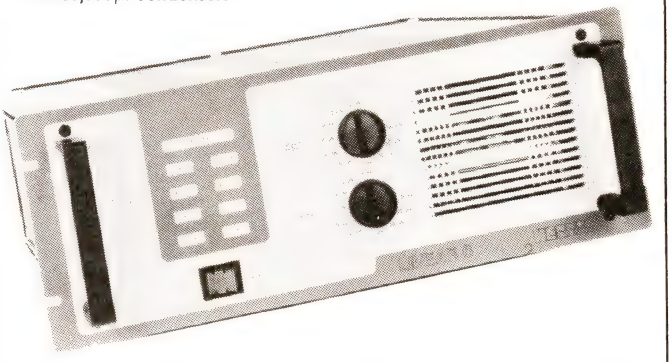
Decent Cannon connectors are a must, and the input circuitry should not be bothered by RF or other interference. Another thing, when you switch the amp on, it shouldn't cause a massive power surge, ▷

THIS AMP IS FANTASTIC! But don't listen to us – listen to it.

ULTRA HIGH SPEED POWER MOSFET AMPLIFIER

Hertz Electronics offers only excellence in their products, both in performance and construction. The Linear/6 is a fine example. Here's just some of its features:

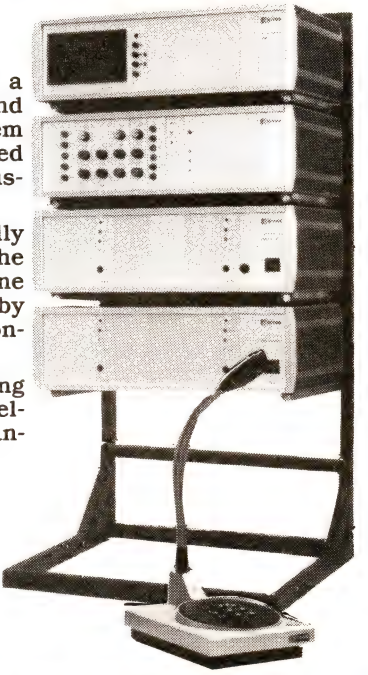
- **Band width 18-400 KHz.**
- **Signal to noise 103 db**
- **Slew rate: 127 V/μs**
- **Circuit breakers, no fuses**
- **Remote control**
- **Jumbo size Toroidal Transformer with two separate secondary windings and 80,000 μF condensers**
- **Throughout 1% metal film resistors**
- **Film capacitors for signal processing**



According to the FOURIER Analysis, an amplifier has to provide a bandwidth 10-20 times higher than the base frequency to reproduce square waves, hence for a crisp, clear reproduction of a 1 kHz square wave a frequency response of 10-20 kHz would be required, for a 10 kHz square wave a response of 100-200 kHz is needed.

Just listen to a Linear-6 amp and you will find out what Fourier is talking about.

MODULAR PAGING AND MUSIC SYSTEM



Hertz electronics offers a fully modular paging and backround music system which can be configured to fulfil any specific customer's requirements.

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For more details contact Norbert Mollers.

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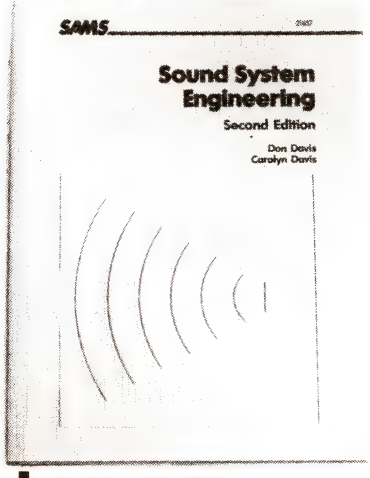
HERTZ ELECTRONICS PTY LTD (INC NSW)

THIS IS THE 'HANDBOOK' OF PA.



Arguably the best practical text ever produced, Don and Carolyn Davis' "Sound System Engineering" covers the vast field in breadth and depth in an easily read style with numerous references. If you want or need mathematical depth, then that's there, too.

In association with the importers of this text, Stewart Electronic Components of Melbourne, we are able to offer this fantastic book at a phenomenally low price, much lower than you'd pay from the usual bookseller outlets.

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because when you power-up a rack full, the house fuses are likely to croak it. A slow power-up facility (sometimes called "soft-start") is really nice to have if you are running multiple amps.

The musician's view

The sound is very important, no matter whether you're playing bass, keyboards or doing the vocals. There is nothing worse than a "flat" sound, it ruins your performance.

When you play through a bad system, you keep returning to the controls all the time because it sounds "off", but it won't "sing" no matter what you do. In the old days, you could use your little Fender twin-reverb or your Marshall stack and get your harmonics. You know, that ballsy, rich type of sound. It's not often you get that these days because the trend is to run everything through the PA, in which case it's gotta be a good one, otherwise when the bass player hits bottom E, it chops up the vocals. You need a "musical" amp, not a "flat" one.

Use and abuse of PA amps

Considering the treatment dished out to this equipment, how can you abuse them? Here's a list of things that will shorten the lifetime of any PA amplifier:

OVERHEATING. The hotter the amp runs, the worse it is for *all* components. Ensure that the cooling vents are not obstructed and if air filters are used, clean them out occasionally. When installing the amp in a case or rack, make sure that there is as much air flow as possible — amps using bipolar transistors are especially critical; MOSFET amplifiers less so.

DUST BUILD UP. Every few months or so, you should take the lid off and, with an air compressor, blow out all the dust and fluff. This build-up, if left to accumulate, collects moisture and provides leakage paths, and can upset critical bias values, etc.

RUNNING INTO CLIPPING TOO OFTEN. The situation can be likened to redlining your car too often — it certainly won't do it any good, and most of the time, you won't benefit at all in terms of output. It is always a good practice to back off the volume control a bit and let the clip lights just blink on the heavy peaks. The amplifier and speakers will reward you with longer, more faithful service and the patrons will enjoy the music more.

Summary

Running a high powered PA system is very much like driving a Ferrari — let a young revhead take it out for a burn and you will spend a lot of time waiting in a garage for a very expensive repair bill. You can get around the block just as quickly, and more comfortably, if you don't smoke up the tyres around every corner and race-change way over redline all the time.

Consider your speakers as your tyres, the clipping lights as the redline, the mains as the petrol and the cooling as the oil — follow the above suggestions and you will benefit.

When choosing a PA amp, check these characteristics in this order:

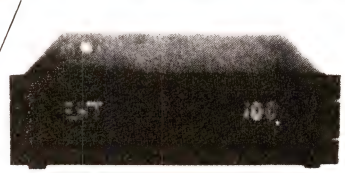
- Reliability
- Performance
- Quality of construction
- Service facilities

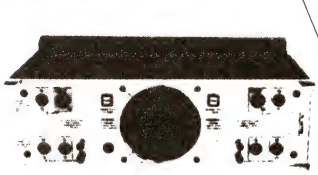
Also look for the inclusion of features such as:

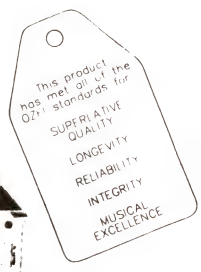
- slow power-up
- clipping indicators
- short-circuit protection
- power-on muting
- thermal protection
- MOSFET output devices
- Toroidal transformers

Follow the recipe and you'll be well-rewarded with equipment that does what you require of it.

THE ONLY PROFESSIONAL POWER AMPLIFIER TO BE APPROVED BY OZFI — THE AUSTRALIAN HI-FI MANUFACTURERS GUILD







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ELECTRON HANDLING TECHNOLOGIES

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Just 3 rack units high — super strong, ultra light all alloy chassis — EHT-2000 weighs only 24 Kg — Toroidal Transformers — fully independent power supplies — fully protected against shorted outputs and thermal over-load — power-up anti-surge circuitry eliminates excessive current drain at switch-on — switch-on thump suppression — transformerless balanced inputs protected against excessive input voltage and R.F. interference — fully complementary/balanced and thermally stabilised Octa-differential driver network — Bipolar clipping indicators — plus many more features too numerous to mention.

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VIC.: Pro Music (03) 300 2055. S.A.: Musitronics (08) 297 8932. W.A.: Marketec (09) 242 1119. TAS.: Tasfi (004) 25 5224.

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One for all, all for one.

PERFORMING

"When I started my first band, more years ago than I care to remember – Crown was then, as it is now, definitely the amp to have. But at that time I felt beginning with Crown power was a little like taking Driver's Ed. in a Ferrari.

"As things started picking-up, we found ourselves loading in and out of a different club every weekend. It was becoming clear our equipment wasn't quite as ambitious and durable as we were. We learned quite an expensive lesson by not having Crown from the beginning."

Al Evarts,
The Duke Tumatoe Band
Indianapolis, Indiana

With the advent of the **Power-Base™ Series**, today even the entry level musician can afford to have the legendary performance and reliability of the Crown product.

Crown's ability to provide light weight power and dependability at a price that is both surprising and affordable is the essence of the **Power-Base Series**.

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"An amplifier must display two virtues for any given tour – it must have excellent sonic quality and it must be indestructible.

"For all of our tours we choose Crown."

The introduction of the **Macro Tech™ Series** brings a new dimension of Crown engineering to the tour – the natural progression of advancing technologies has brought about a new series of astounding amplifiers. Expanding on the incredible success of **Micro Tech®**, Crown now brings you **Macro Tech**, a series built on the premise that to succeed in any business one must never rest on one's laurels.

Developed in the usual way, by testing thoroughly before it is ever brought to the market, the new **Macro Tech** is every bit – Crown.

Craig Schertz,
Showco
Dallas, Texas

"Showco has depended on Crown for years – a company you stake your reputation on must be a company you can rely on. In short – if the amp doesn't work neither do we.

RECORDING

"It's a very simple matter really – I have never used another product I like better when it comes to powering a studio. True reproduction is the main intent here at Westlake. Though we have tried other products we have always returned to Crown and the PSA-2."

The Crown **PSA-2** has been an industry standard since its introduction. Professionals like Joe Gorfinkle rely on Crown to produce the results they expect, no compromise – no short-cuts.

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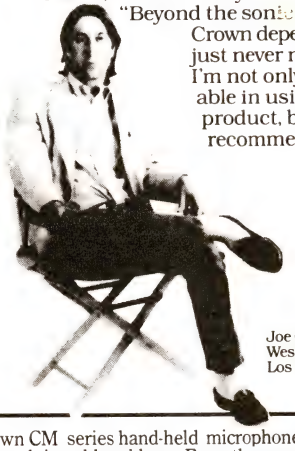
"Beyond the sonic quality is Crown dependability, they just never need attention. I'm not only very comfortable in using the Crown product, but also in recommending it."



Joe Gorfinkle,
Westlake Audio
Los Angeles, California

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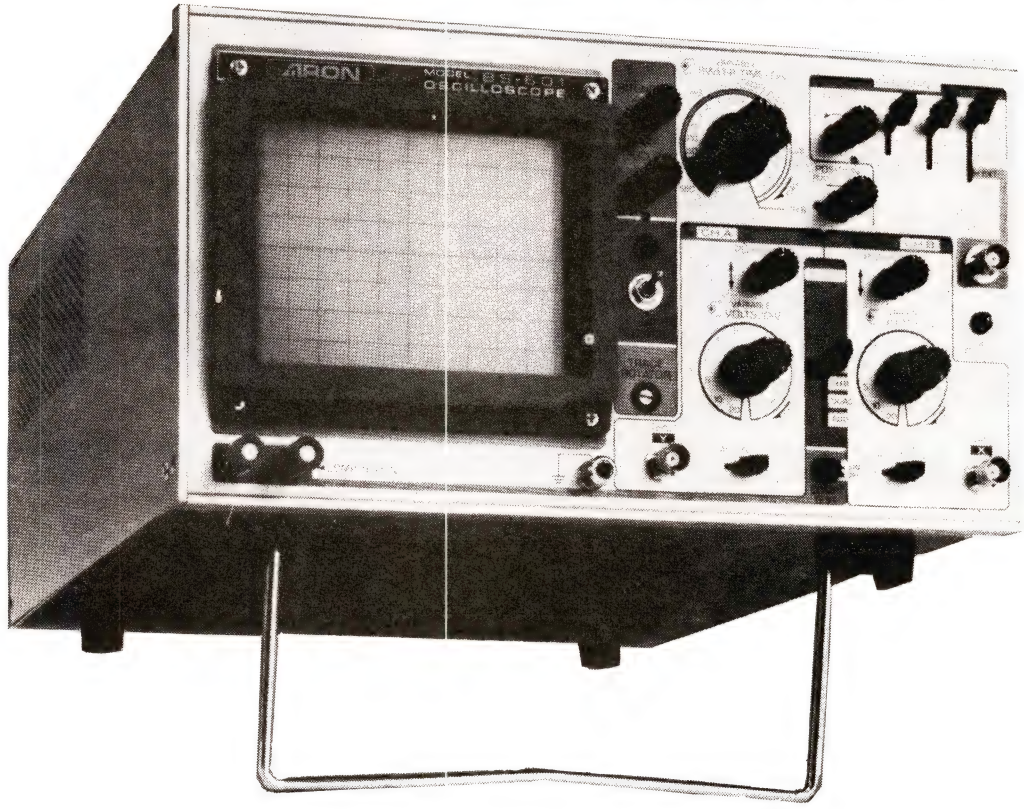

You could win an Aaron dual-trace 20 MHz CRO with built-in component tester, model BS-601. Nearly $900 value!

1) Where does the 'cathode dark space', or 'Crooke's dark space', appear in a cathode ray tube?

. . . . . .

2) In 1967 Elmeasco Instruments commenced operations in small offices in a well-known Sydney suburb. Which suburb was this?

. . . . . .

3) What shape would you expect to be displayed on the Aaron BS-601 oscilloscope if a capacitor were being tested using the component tester?

. . . . . .

How would you put the Aaron dual-trace 20 MHz CRO to good use? Tell us in 25 words or less.

I have read the rules of the contest and agree to abide by their conditions.

Signature: _____

Name: _____

Address: _____

_____ P/Code: _____

Phone: (___) _____

Here is a golden opportunity to own this versatile general purpose 20 MHz CRO from Aaron. It boasts a large 150 mm flat-faced high brightness CRT with internal graticule. The two inputs may be displayed separately, added or inverted. The trigger coupling mechanism features TV Sync Vertical and Horizontal Sync Separator Circuitry, which allows any portion of complex TV video waveforms to be synchronised and expanded for viewing.

Vertical sensitivity can be set between 5 mV – 20 V per division, in convenient 1-2-5 steps. Horizontal calibration is between 0.2 μs – 0.5 seconds per division, with the sweep magnifier providing 5x enlargement for clearer viewing of complex waveforms.

The in-built component tester quickly and easily displays graphically the characteristics and values of components such as resistors, diodes, capacitors, individual transistor junctions etc., unambiguously showing where any fault may lie. Semiconductors can be matched for similar characteristics, and suspect components can be tested without the need to apply power to the circuit.

Prize kindly donated by Elmeasco Instruments Pty Ltd.

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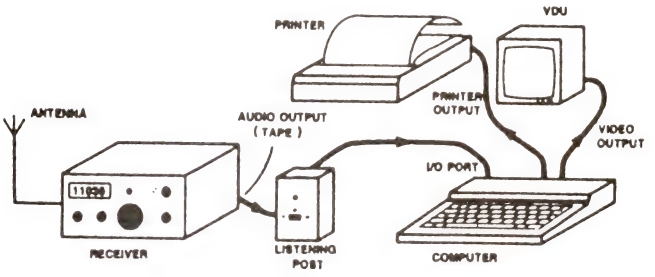
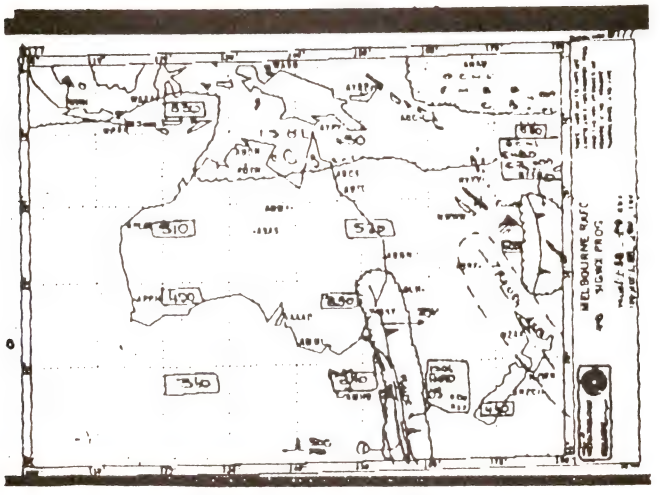
Using the Australian Electronics Monthly "Listening Post" (AEM3500) project, you can tune-in to the myriad of non-voice transmissions on shortwave and decode them! All you need is a shortwave receiver with SSB reception, the AEM3500 Listening Post, computer and software. Be the first on your block to receive weather pictures and foreign news bulletins – USEFUL and FASCINATING.



Get the Most Out of Your Receiver!



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Both packages include full instructions for building the Listening Post project and application notes for your computer.

Send to: "AEM Listening Post Software", 1st Floor, 347 Darling St, BALMAIN 2041 NSW.

*You must include a blank C10 cassette or **formatted** disk.*
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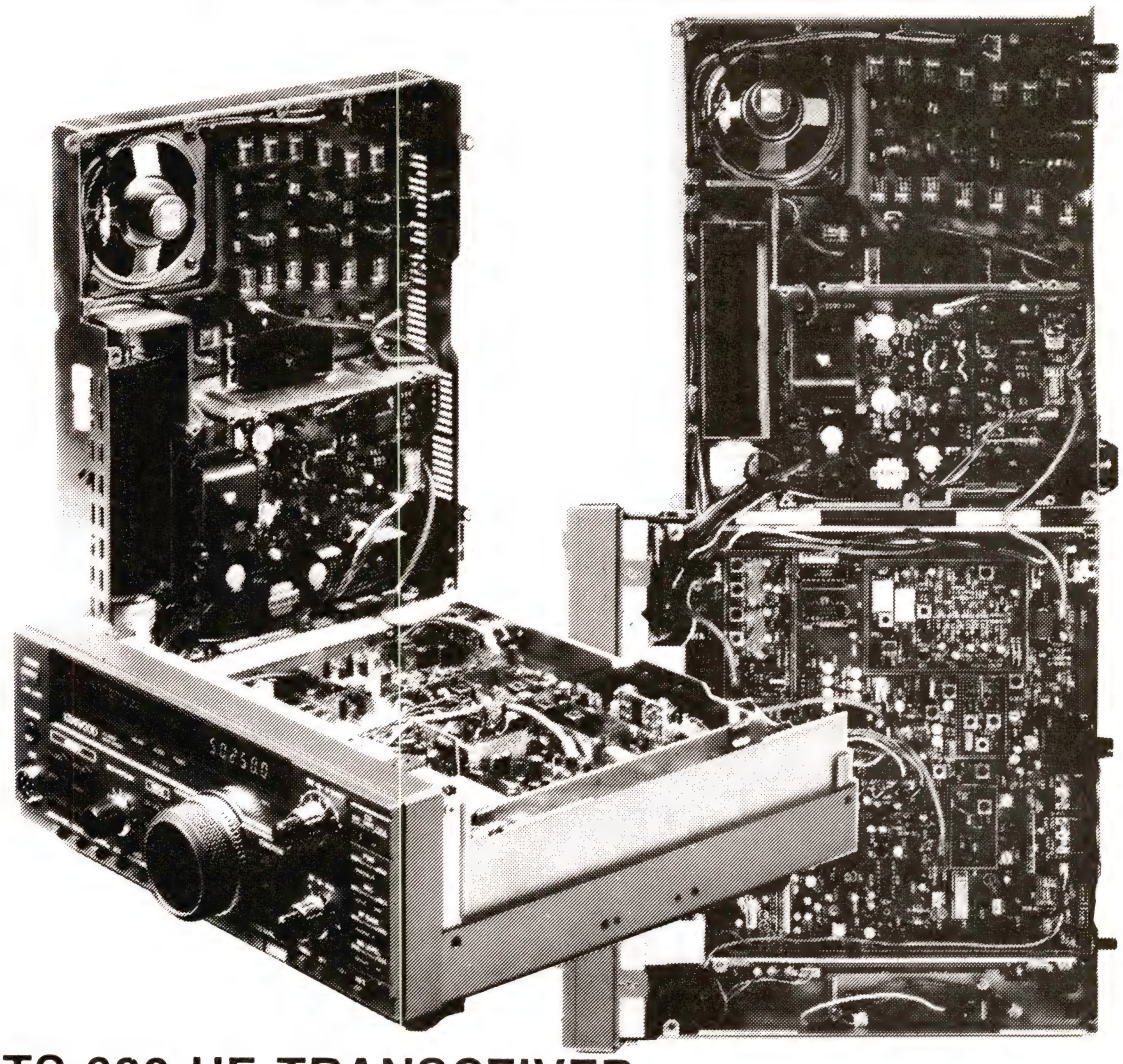

TS-680 HF TRANSCEIVER

100 WATTS OUTPUT ON 160 to 10 METRES
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The TS-680 is a high-performance HF transceiver designed for SSB, CW, AM and FM modes of operation on all Amateur bands. Covers Amateur bands 160 metres to 6 metres, combining the ultimate in compact size with advanced technology.

Compact and lightweight. CW Full Break-In, Semi Break-In and VOX Circuit. Superior receiver dynamic range. The receive front end has been specifically designed to provide superior dynamic range. The intermodulation dynamic range is 102dB, with an overall intercept point of + 12dBm, noise floor level of — 138 dBm. (when the optional 500 Hz CW filter YK-455C-1 installed). 31 Memory channels with split memory channels and memory scroll. Built-in dual-mode noise blanker ("Pulse" or "Woodpecker".) IF shift circuit. Adjustable VFO tuning torque. Switchable AGC circuit (FAST/SLOW) and built in speech processor, RF output power control and "F.LOCK" switch. Non-volatile operating system. Fluorescent tube digital display and squelch cicruit (for FM mode).

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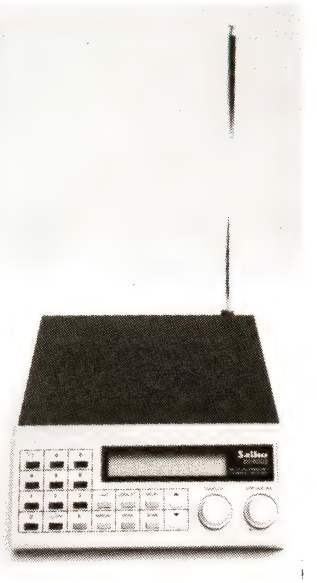
New Saiko scanner covers five popular bands from 26 through 512 MHz



Saiko's new SC7000 scanner features coverage of the popular upper-HF, three VHF and one UHF bands and offers performance and facilities normally associated with much more expensive unit.

Frequency coverage offered is 26 to 30 MHz, 68 to 88 MHz, 118 to 138 MHz, 138 to 178 MHz and 380 to 512 MHz.

The SC7000 sports a very comprehensive liquid crystal display showing reception mode, channel, frequency and channel step.

Search functions provided a quite comprehensive and you can step through the bands in 5 kHz, 12.5 kHz or 25 kHz steps.

Up to 50 channels may be included in the receiver's memory and you can scan through them using a delay on each channel, blockout certain channels and set a priority channel to monitor.

Sensitivity is quoted as 0.5 microvolts. It is powered from a 12 Vdc source. A whip antenna and internal speaker are included. All this for $695.

The Saiko SC7000 is being promoted by, and is available from, leading scanner specialist, **Captain Communications, 28 Parkes St, Parramatta 2150 NSW. (02)633 4333.**

New UHF CB rig

Standard Communications has released a new UHF CB transceiver under its Electrophone label, model TX472S, manufactured at their Gladesville factory in Sydney.

The new rig covers the full 40 channels of the 476.425 to 477.400 MHz UHF CB band and features two modes of field programming and scanning. Output is given as five watts on transmit, the legal limit.

Group scanning allows you to select any group of nominated channels along with their own selected priority channel, whereas open channel scanning allows all 40 channels to be scanned.

You can select and monitor air traffic channels or fire brigade channels – all without having to have the rig adjusted or modified by a local technician.

The TX472S emploits state of the art electronic and manufacturing technology. Further details are available from **Standard Communications, PO Box 296, Gladesville 2111 NSW. (02)816 2198.**

Just testing

A versatile communications test set from Schlumberger of West Germany has been released by Tech-Sales Pty Ltd. Known as the Model 4040 Radio Communication Test Set, it provides coverage for testing transceivers from 400 khz to 960 MHz.

Built-in test routines allow measurements of sensitivity, bandwidth, centre frequency, squelch, modulations sensitivity, adjacent channel power, harmonics and spurious radiation.

An optional extension provides coverage up to 1.85 GHz.

Selective call testing facilities are also provided, as well as cellular radiotelephone tests.

Automatic test routins may be performed from stored programs and an optional control interface enables program control. A printer can be connected to provide hard copy of test results.

Further details from **Tech-Sales Pty Ltd, 12 Maroondah Highway, Ringwood 3134 Vic. (03)879 2266.**

3.5 GHz spectrum analyser weighs just 10 kg.

AWA Distribution, Industrial Group, has released a 3.5 GHz spectrum analyser range that weigh just 10 kg each, the R4131 Series from Advantest.

Luggable, but hardly portable, the R4131 incorporates the performance of the already popular TR4131 Series of 3.5 GHz analysers. There are four models in the R4131 Series.

These instruments have a measurement-condition memory function which includes waveforms, an auto-recall which recalls measurement conditions when power is switched on, and other features, all to simplify operation.

The R4131 features a maximum input sensitivity of –116 dBm, a dynamic range of 70 dB and a skirt characteristic of –80dBc or better, according to the manufacturers.

More information is obtainable from Industrial Group, AWA Distribution, 112-118 Talavera Rd, North Ryde 2113 NSW.

32nd annual Field Day for Gosford Amateur Radio Club

Launched three solar cycles ago, the annual Gosford Amateur Radio Club Field Day is a major event on the amateur radio calendar in Australia.

Next year it will be held of Sunday 19th February, at the usual venue – Gosford Showground.

The event includes popular displays from distinguished companies such as Emtronics, Icom, Kenwood, Dick Smith and AEM!

The Field day is famous for its hidden transmitter hunts and other contest events, for which a formidable array of very attractive prizes is always offered.

The "disposals" sale is probably still the most popular part of the proceedings – where hordes bring along their unwanted equipment (which they probably bought there a year or two earlier!), or junk (depending on your view), to sell, and even bigger hordes queue up to pick it over!

This year will see the inauguration of a special event: a home made 70 cm antenna evaluation test. Start now if you're considering entering.

More details on the programme as time goes on. In the meantime, for more information, contact **Bren Connolly VK2BJC on (043)23 1662.**

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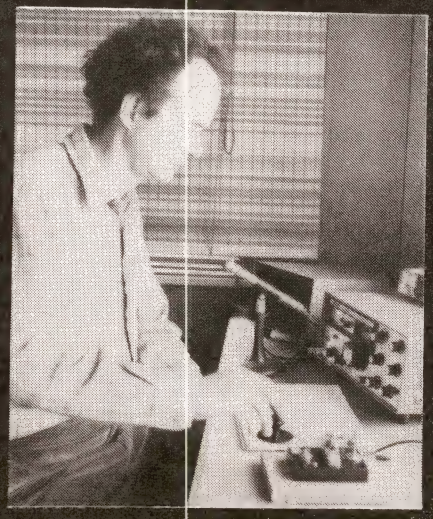
The Wireless Institute of Australia is a non-profit society founded in 1910. Since its inception it has nurtured the interests of all Australian amateurs by liaison at all Governmental levels.

Apart from many other benefits as a member, you receive a monthly plastic encapsulated 64 page magazine called Amateur Radio in your letter box each month.

This magazine contains information on all aspects of the hobby such as Technical Projects, Hints and Kinks, Computer Programs, Free Classified Advertisements and Technical Reviews. Regular columnists give details of Contesting, Awards, DX News, Ionospheric Predictions and Solar Activity, Overseas News and VHF/UHF Activity, to name but a few.



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Novices! Welcome to two metres – a primer, Part 2

Roger Harrison VK2ZTB

To get the most from your two metre rig, you need good connections.

AS FORESHADOWED in Part 1, this article introduces the various common antenna connectors you'll run across and details their characteristics, strengths and weaknesses. Over the page, you'll find step-by-step instructions on how to properly fit them.

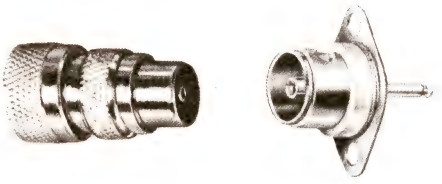
As coaxial cable is pretty well universally used on two metres, you'll encounter coaxial-type connectors. The less expensive types simply afford a connection while maintaining the coaxial structure of an inner conductor surrounded by a cylindrical outer conductor. The more expensive "precision" coax connectors have a "constant impedance" characteristic, which means that their construction preserves the characteristic impedance of the cable to which they're attached.

Clearly, the latter are preferred as they do not introduce sudden impedance "bumps" in the line between the antenna and the rig which is a source of loss. Though small, such losses can be important, particularly affecting the sensitivity of a low noise RF stage in a receiver. However, two metre FM operation can be fairly forgiving. If you're not after the last dram of juice, you can afford a few compromises — but perhaps not too many all together!

There are four common coaxial connector families you'll encounter, all of which may be found on two metre gear of some description, be it the latest commercial rig, homebrew gear or ex-commercial VHF "high band" two-way equipment modified for operation on 2m. Let's take them one-by-one, from the least expensive to the most expensive.

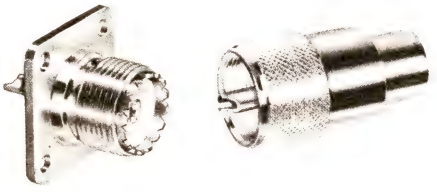
I have listed here *price ratios,* taking the least expensive connector (plug) as the reference. Thus, if it were $1, another connector with a price ratio of three would cost about $3. The ratios are approximate only.

TV ("PAL") series



The common, low-cost coax connector for TV installation. Meant for small diameter 75Ω coax (e.g: RG59), but not a constant impedance connector. Serviceable, but not very rugged. The plastic-bodied type plug is the cheapest - price ratio of 1. The metal-bodied type is somewhat more rugged, but has a price ratio around 1.8.

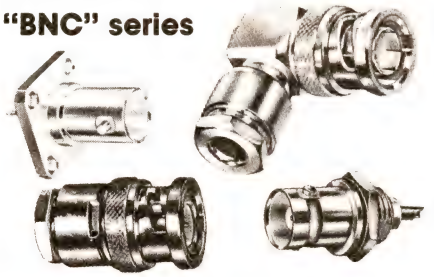
"UHF" series



This comprises the famous PL259 plug and SO239 socket combination which has a long and honourable history. Widely found on commercially made amateur gear. Generally rugged and reliable, it features a locking action when screwed together, but is not a constant impedance connector, despite the "UHF" title.

Originally meant for larger diameter coax, adaptors are available for the plugs to take the smaller coax as well as models designed to fit. Both straight-through and right-angle plugs are obtainable. Some recent incarnations of the plug require no soldering. Price ratio of two for the cheaper versions, up to four for quality plugs.

"BNC" series



A "precision" constant impedance connector meant for smaller diameter coax (RG58, etc). Both 50Ω and 75Ω versions are obtainable. The BNC offers a quick-connect/disconnect facility, is rugged and reliable. It is often found on handheld 2m rigs. Adaptors for the plugs are available to accommodate 3 mm coax (RG174). The BNC (75Ω type) is a widely used video connector.

Like the UHF, both straight-through and right-angle plugs are obtainable. A low-cost version of the socket features a bifurcated (split) pin rather than the four-fingered collet of the "true" BNC socket. It's not truly a constant impedance socket, but quite OK on 2m. Price ratio ranges from two for the lower-cost versions, up to five or so for the quality types.

"Type N" series

Another "precision" constant impedance connector, meant for larger diameter coax (RG213, etc). This, too, is a rugged and reliable connector. It is pretty well weatherproof if all the seals are used and properly installed. Ideal for outdoor installation. Like the UHF and BNC series, the Type N has a long an honourable history. Plug adaptors to accommodate RG58-type coax are available as well as some versions made to fit, and both straight-through and right-angle plugs are obtainable. Price ratio starts at seven and ranges to ten and higher. ▷

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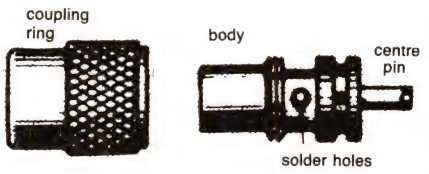
HOW TO TERMINATE COMMON

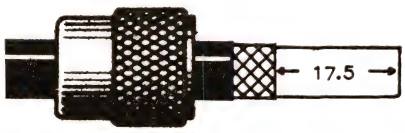
PL259 ('UHF' TYPE)

For large diameter 50 or 75 ohm cables.

1: Cut the end of the cable square. Carefully cut through and remove the outer sheath 28.5 mm from the end, taking care not to nick the braid beneath.

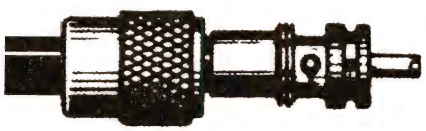


2: Disassemble the connector.

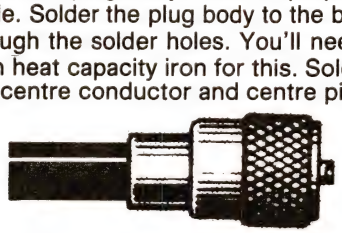


3: Slide the coupling ring onto the cable. 17.5 mm back from the cable end, carefully cut through the braid and remove the end bit. Using a hot iron, lightly tin the remaining exposed braid.

4: Remove 16 mm of dielectric, taking care not to nick the centre conductor. Using a hot iron, lightly tin the centre conductor.



5: Fit the plug body onto the prepared cable. Solder the plug body to the braid through the solder holes. You'll need a high heat capacity iron for this. Solder the centre conductor and centre pin.



6: Screw the coupling ring down over the plug assembly.

PL259 ('UHF' TYPE)

(with adaptor)

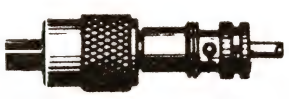
For small diameter (4.95, 6.15 mm o.d.) 50 or 75 ohm cables.

1: Cut the end of the cable square. Carefully cut through and remove the outer sheath 19 mm from the end, taking care not to nick the braid beneath.

2: Disassemble the connector.

3: Slide the coupling ring and adaptor onto the cable sheath. Fan back the braid over the sheath. Slide the adaptor down to it and compress the braid over it. Trim off excess braid.

4: Remove 16 mm of dielectric, taking care not to nick the centre conductor. Using a hot iron and working quickly, lightly tin the centre conductor.



5: Screw the plug body onto the adaptor. If you wish, you may now solder the braid to the body through the solder holes. You'll need a high heat capacity iron for this. Solder the centre conductor and centre pin.

6: Screw the coupling ring down over the plug assembly.

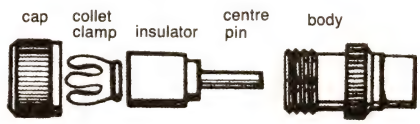
Tools: you will need a sharp 'hobby' knife or penknife; sharp, small-bladed sidecutters; small adjustable spanner; long-nosed pliers; soldering iron.

BELLING-LEE ('PAL') PLUG

For 75 ohm 6.15 mm o.d. coax cable (e.g: RG59A/U)

1: Cut the coax cable end square. Carefully cut through and remove the outer sheath 22 mm back from the end, taking care not to nick the braid beneath.

2: 16 mm back from the cable end, cut through the braid and dielectric, right through to the centre conductor, taking care not to nick the latter. Using a hot soldering iron, quickly and lightly tin the centre conductor.



3: Disassemble the connector.

4: Slide the cap and collet clamp over the cable. Seat the end of the collet clamp just at the end of the outer sheath and lightly squeeze the collet fingers to hold it in position. Comb out the braid and fan it back over the collet clamp.

5: Slip the centre pin sub-assembly on the cable, seating it well back on the braid and collet. Quickly solder the centre conductor to the plug's centre pin. Take care to not overheat it or else you'll melt the insulator.

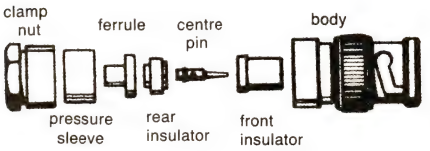
6: Push the plug body onto the sub-assembly, ensuring it seats properly with the centre pin more or less flush with the end of the plug body. Screw the cap onto the body, forcing the collet clamp fingers onto the coax sheath.

RF CONNECTORS

BNC MALE

For 50 ohm, 4.95 mm o.d. coax cable (e.g: RG58C/U)

1: Cut the end of the cable square. Carefully cut through and remove the outer sheath 8 mm from the end, taking care not to nick the braid beneath.



2: Disassemble the connector.

3: Slide the clamp nut and rubber pressure sleeve over the cable. Carefully comb out the braid with a scriber point or small screwdriver blade.

4: Fold back the braid and insert the ferrule between the cable's braid and dielectric so that the ferrule's flange seats firmly against the braid and sheath. Trim off the excess braid with sharp sidecutters.

5: Remove 5 mm of dielectric, taking care not to nick the centre conductor. Using a hot iron and working quickly, lightly tin the protruding centre conductor.

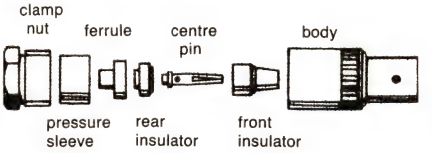
6: Slide the rear insulator over the cable centre conductor, pushing it hard against the ferrule. Then slide the centre pin on the centre conductor. Apply the hot iron tip to the body of the centre pin to preheat it, leaving the small hole in it upturned. After a few seconds heating, apply solder to the area of the hole in the centre pin and see that the solder flows freely. Don't apply too much solder.

7: Fit the front insulator into the connector body and push it carefully onto the sub-assembly. Slide the pressure sleeve into the body and screw in the clamp nut to secure the cable.

BNC FEMALE

For 50 ohm, 4.95 mm o.d. coax cable (e.g: RG58C/U)

1: Cut the end of the cable square. Carefully cut through and remove the outer sheath 8 mm from the end, taking care not to nick the braid beneath.



2: Disassemble the connector.

3: Slide the clamp nut and rubber pressure sleeve over the cable. Carefully comb out the braid with a scriber point or small screwdriver blade.

4: Fold back the braid and insert the ferrule between the cable's braid and dielectric so that the ferrule's flange seats firmly against the braid and sheath. Trim off the excess braid with sharp sidecutters.

5: Remove 5 mm of dielectric, taking care not to nick the centre conductor. Using a hot iron and working quickly, lightly tin the protruding centre conductor.

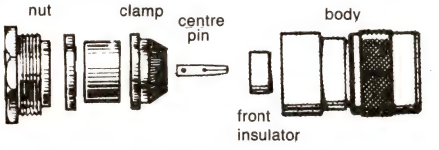
6: Slide the rear insulator over the cable centre conductor, pushing it hard against the ferrule. Then slide the centre pin on the centre conductor. Apply the hot iron tip to the body of the centre pin to preheat it, leaving the small hole in it upturned. After a few seconds heating, apply solder to the area of the hole in the centre pin and see that the solder flows freely. Don't apply too much solder.

7: Fit the front insulator into the connector body and push it carefully onto the sub-assembly. Slide the pressure sleeve into the body and screw in the clamp nut to secure the cable.

N TYPE

For 50 ohm, 10.3 mm o.d. cables (e.g: RG8A/U, RG213/U)

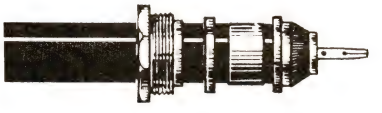
1: Cut the end of the cable square. Carefully cut through and remove the outer sheath 9 mm from the end, taking care not to nick the braid beneath.



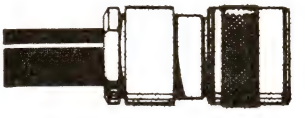
2: Disassemble the connector.

3: Slide the nut, etc and rubber pressure sleeve over the cable. Carefully comb out the braid with a scriber point or small screwdriver blade. Fold back the braid and seat the clamp against it. Trim off the excess braid with sharp sidecutters.

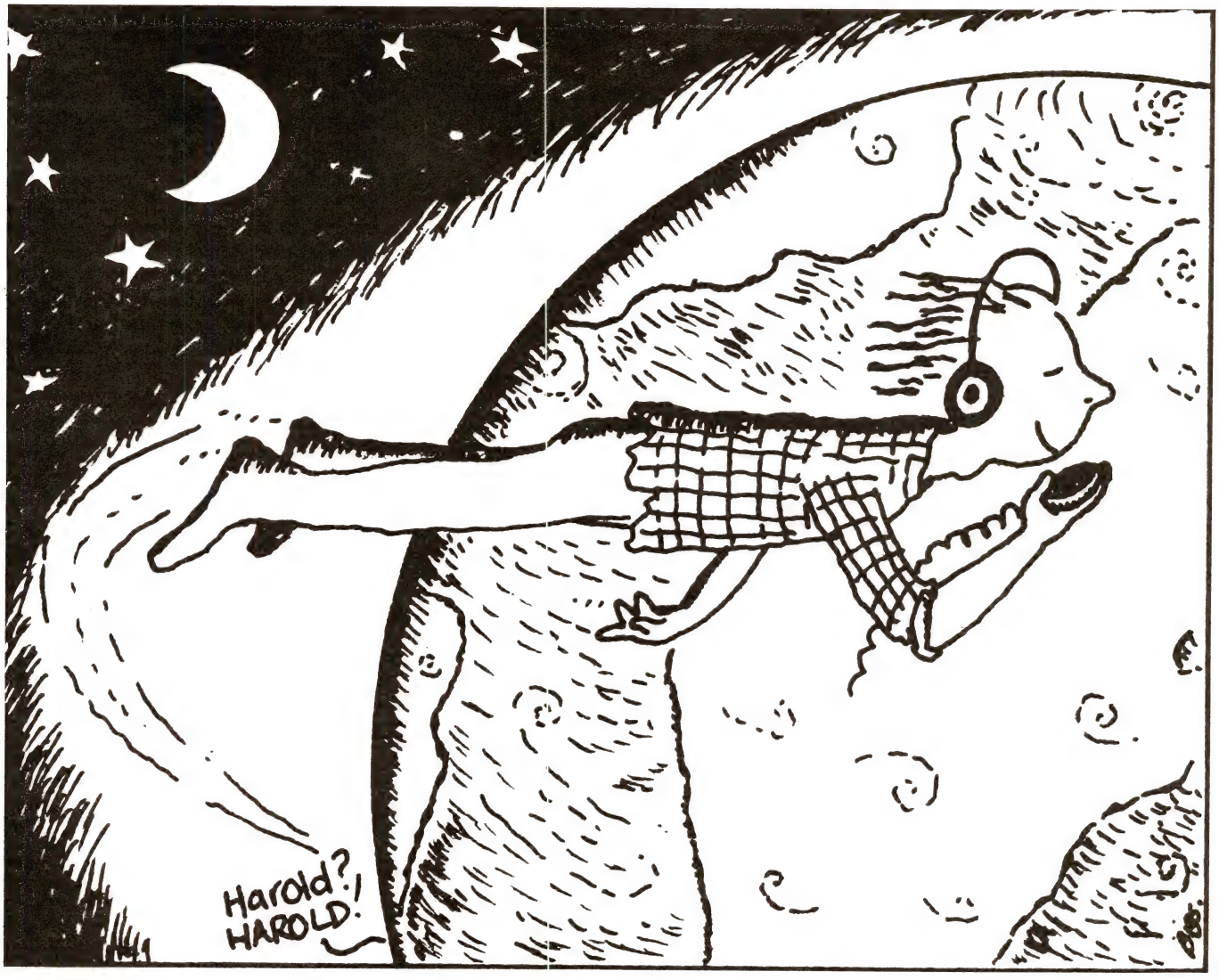
4: Remove 5.5 mm of dielectric, taking care not to nick the centre conductor. Using a hot iron, lightly tin the protruding centre conductor.



5: Then slide the centre pin over the centre conductor. Apply the hot iron tip to the body of the centre pin to preheat it, leaving the small hole in it upturned. After a few seconds heating, apply solder to the area of the hole in the centre pin and see that the solder flows freely. Don't apply too much solder.



6: Fit the front insulator into the connector body and push it carefully onto the sub-assembly. Slide the pressure sleeve into the body and screw in the clamp nut to secure the cable.



Motivation and the Radio Amateur

If you hold an amateur radio licence and anyone ever asks you what you do and/or why, just hand them this.

"YES, Mr Brown, but what do you hams talk about?" is what they usually said to him, and he'd realise then that they would never understand, and he would change the subject.

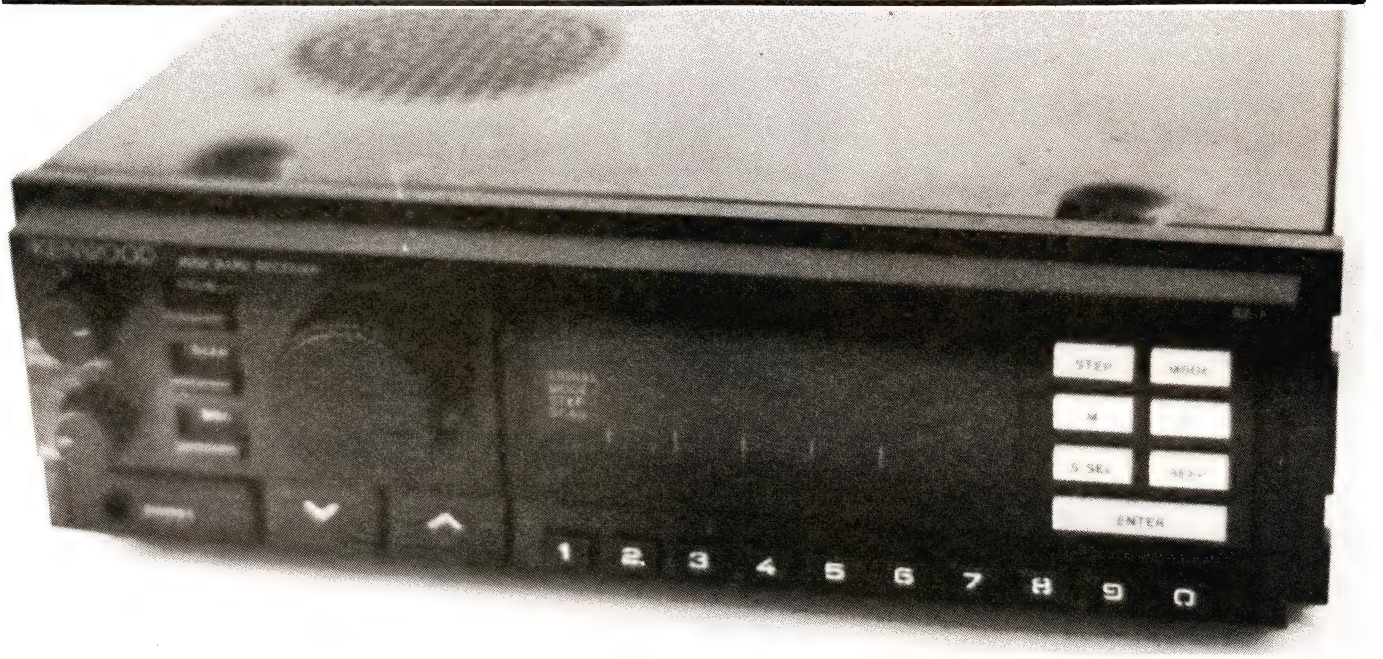
Sometimes, though rarely, he'd come across someone who really dug his hobby, and then you couldn't get him off. He'd go on and on about the feeling it gave him of being able to move himself through time and space, annihilating distance; his mind, his body, his consciousness out there roaming the planet like some cosmic spirit, and the sense of power, benign power, not the evil kind knowing his voice was rattling a loudspeaker in a far-off room in Bombay, or going out through an open window in Johannesburg to someone walking by on the street outside, or filling a room carved out of ice below the frozen wastes at the South Pole.

The here and now, the physical and geographical limitations that all beings are stuck with, would fall away from him as he immersed himself in the action of fifteen metres on a good night in spring when the sunspots were dancing and the ionosphere was in a reflective mood and the short path was open to Indonesia and the Middle East

• to page 122

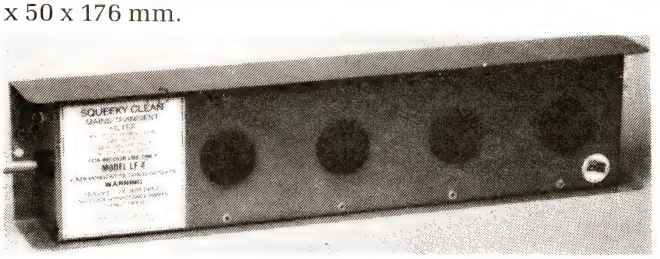
3RD BIRTHDAY CONTEST No.7.

Win this scanner's delight, the Kenwood RZ-1 Wideband Receiver. Worth $1045!



The RZ-1 scanner from Kenwood provides continuous reception from 500 kHz to 905 Mhz. The AM and FM broadcast bands are covered in their entirety. Designed to be installed in a vehicle, but equally "at home" in a base station installation, the RZ-1 operates on 12 Vdc and can accept either a Motorola-style antenna plug or the PL-259 style familiar to mobile transceiver users.

Boasting 100 memory channels, the RZ-1 stores not just the frequency, but also the mode of the station as well as an optional seven-character alphanumeric identifier. Unlike many other scanners, the RZ-1 is ideally suited to replacing a standard car radio, as it duplicates all the conventional broadcast band functions as well as providing a wealth of features for MF, HF, VHF and UHF reception. All of these features are available in a remarkably compact package, measuring only 180 x 50 x 176 mm.



You can use it mobile, or use it at home! *And* we'll throw in a "Squeeky Clean" LF-4 Mains Filter from local manufacturer K.C.C., so you can pull in those signals free from mains-borne interference.

The Kenwood RZ-1 was reviewed in our June 1988 issue.

Prize kindly donated by Kenwood Australia.

1) Who is the Communications Products Manager for Kenwood Electronics Australia?

. . . . . .

2) Would you or would you not be able to pick up the Kingsford Smith weather broadcast on the Kenwood RZ-1 receiver?

. . . . . .

3) In what Sydney suburb is filter manufacturer K.C.C. located?

. . . . . .

Tell us, in 25 words or less, what features of the Kenwood RZ-1 receiver best suit your needs.

I have read the rules of the contest and agree to abide by their conditions.

Signature: _____

Name: _____

Address: _____

_____ P/Code: _____

Phone: (___) _____

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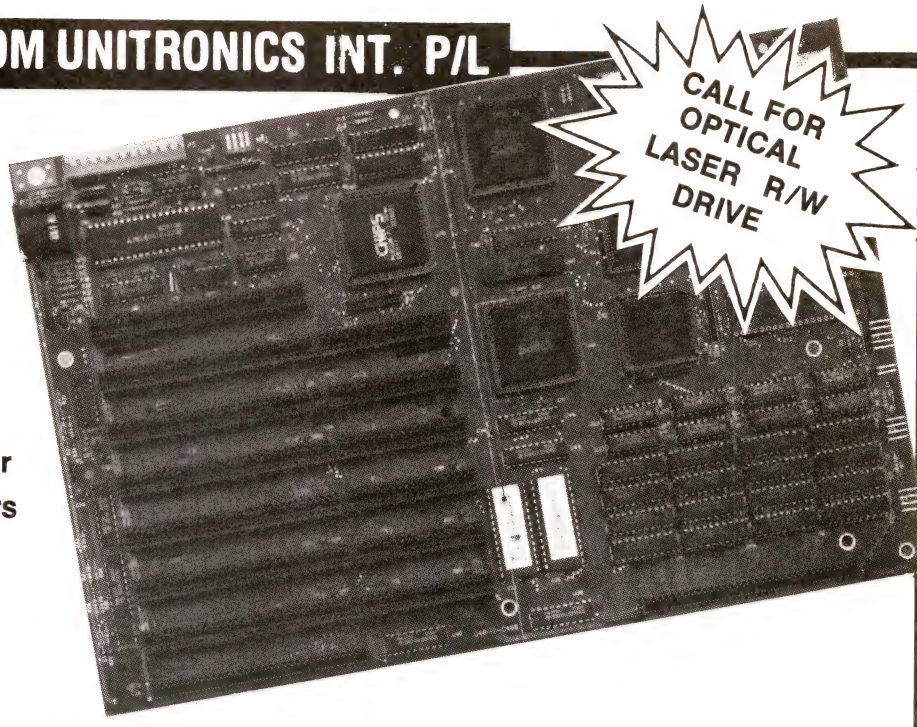

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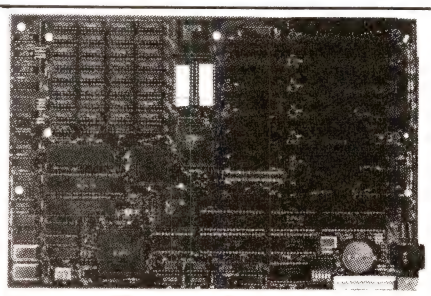

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Three heads are better than one in the digital darkroom

A computer can be turned into a virtual "digital darkroom" according to AT&T Bell who have developed a programming language that allows the computer to mimic everything a skilled professional can do with a photographic negative using chemicals and enlargers in a darkroom.

For example, it can smoothly fade a picture from a negative to positive version, twist a picture into a spiral, and restore focus in a fuzzy picture. (Does it remove facial wrinkles? — Ed.)

With the new language you can shift images on the screen, merge separate images on and or cut and paste colour values, even sharpen or soften focus.

The picture you see here was produced from a single image using the special software.

The editor was designed to run on computers using the UNIX system. It will also operate on personal computers that don't run UNIX. However, it will operate slowly and take a fair amount of memory to store if processed at high resolution.

Computer Doctors offer voucher service

Computer Doctors, a well-known computer and peripherals maintenance company are offering what appears to be a unique service called "Flexi Cover" which allows you to purchase your service virtually as you need it.

Unlike conventional maintenance contracts, Flexi Cover vouchers are valid for three years and are not equipment specific. This allows for additions to and upgrading of existing equipment without any additional expense or administration.

With Flexi Cover voucher you only pay for the service that you use rather than a contract fee which is paid in full whether the services are used or not.

Three different services are available, comprising crisis, emergency, and return-to-workshop service.

With the crisis service an engineer will be in your office within 90 minutes and within three hours if you elect emergency service.

For further information contact **Yvonne Beugeling, Computer Doctors, (02)223 3644.**

NEC release CD-ROM drives

The advantages of CD-ROM as a computer data storage medium are slowly filtering through and more software of a truly useful nature is gradually appearing. Pioneers of the media, Philips and Sony, have been plugging the hardware and the concept for several years now, and their educative efforts are paying off as hardware and software suppliers expand.

One use for CD-ROM is electronic publishing; a single CD-ROM has the ability to store all the volumes of the Grolier Encyclopedia.

The disc is easier to store, they cost only a fraction of the printed volumes and any page can be called up in seconds, we are confidently told.

Now NEC joins the bandwagon with the release of two CD-ROM drives, one for "external" use, the other for "internal" use. Sounds like medication instructions for a proprietary product from the local chemist!

The external model is compatible with IBM PC/XT and AT models and compatibles, as well as the Apple Macintosh Plus, the SE and Macintosh II.

The internal model fits in IBM PC/XT and AT models and compatibles, and in OS/2s with standard 5.25" mounts.

A range of interface kits is available to ensure the units can be plugged easily into most personal computers. So if you change your computer, you won't have ditch your CD-ROM.

For further information, contact **Geoff Cottee at NEC, (02)868 1811.**

DOS courses for PC users

Don't know what to do when your computer shows you its DOS prompt? What does it look like anyway?! Don't you worry about that, said someone famous, it will be taken care of.

If you contact Sydney company, Rigi Digi Data, they'll give you the good oil. The company has developed a one-day course ▷

GM-6 Plus Mouse $149
Microsoft & PC Mouse compatible
Includes: Mouse, mouse driver, menus, menu maker, Dr.HaloIII, mouse pad & pocket

101 MACROS $80 for LOTUS, SYMPHONY, dBASE III+

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P.O. BOX 87, MERRYLANDS N.S.W., 2160
FAX: (02) 682 4521

of particular benefit to IBM PC or PC/compatible microcomputer users who are already familiar with one or more PC packages - for example, word processing - but who do not feel confident executing DOS commands.

The course outline cover such aspects as: a short introduction to PCs, disk formatting, creating directories and naming files, backing up and restoring files, and removing directories.

The course has maximum of six students per course — so close attention is assured. Morning and afternoon tea is included.

Emphasis is placed on hands-on exercises at the computer on each topic to ensure thorough understanding. A course exercise workbook and DOS notes are provided for the student.

For further information, call **Kim or Peter at Rigi Digi data, (02)517 2615.**

Logic analyser support for 25 MHz 68030

Tektronix has announced what they claim to be the first logic analyser support for Motorola's 25 MHz "super" CPU, the 68030, on their 1240/1241 Logic Analysers.

The support comprises a 12RM33 68030 Mnemonics ROM Pack and the PM206 68030 Personality Module. These provide a quick and convenient interface between a 68030 microprocessor and the 1240 or 1241 logic analysers.

The PM206 provides a low-profile, low-capacitance probe connector; 68030 clock frequencies up to 25 MHz are supported. All valid 68030 bus cycles are acquired.

The 12RM33 offers setup and disassembly post-processing of data acquired from the 68030. Disassembly of the full instruction set plus the floating point co-processor's instruction set are also supported.

With this and a 1240 or 1241 analyser, you can debug software and hardware, integrate hardware and software and optimise system performance.

Further details are available from your local Tektronix office.

Take charge of your PC

Billed as the ultimate in utility packages, Take Charge! combines a host of useful operating utilities for the PC owner, including a shell menu system, a notepad, calculators, roladex and other Sidekick-like facilities.

To get all the facilities of Take Charge! in a single package,

you'd need to fork out around $1600, says Peter klanberck of Logo Computer Centre, but Take Charge! only costs $299.

Version 1.1 is now on-sale. We've had a copy on-trial here at AEM and it's a little ripper. It's easily learned and operated by the computer-just-literate as well as the seasoned user.

The individual facilities offered are at least match of similar commercially available software and you'd take forever to find similar PD programs which often don't measure up. And in Take Charge!, it's all bundled together in a single package.

Contact **Logo Computer Centre, Suite 303, Henry Lawson Business Centre, Birkenhead Point NSW. (02)819 6811.**

Mix-n-match portable from Epson

Epson Australia has released a versatile little PC-compatible portable, the PX-16, aimed at the industrial, scientific and commercial markets.

Its versatility lies in the flexibility of its system configuration: Epson offer a choice of keyboards, screen units, cartridge interfaces, expansion interfaces and disk drives.

The PX-16 is based on the V20 processor and comes with standard 256K of main RAM, expandable to 1.4M. It has switch-selectable clock speeds of 4.77 and 10 MHz.

The 512K system ROM includes MS-DOS v3.2, GWBASIC and a range of utilities. No system floppies required!

The PX-16 has an A4-sized footprint and it can use all XT-compatible software, Epson claim. It comes with built-in ports for disk drives, a parallel printer and RS232 port and a bar code reader. Epson cover the PX-16 with a full 12 month warranty.

You can choose between an 80 column or a 40 column screen and an interface to drive a standard colour monitor is also available. In keyboards, you can choose between standard typewriter style or a touch screen.

In disk drives, you can choose between a single 3.5" FDD 720K drive, dual 3.5" FDD 720K drives, a single 3.5" FDD and 20M hard disk, or external dual 5.25" 360K floppies. See your local Epson dealer.

Want to get into the 68000?

So far as do-it-yourself computer systems are concerned, it seems the Motorola 68000 might have missed the boat. But only might have. Student or enthusiast, if your interest is the 68000, apply your mind to the Applix.

Sydney company Applix P/L has developed an interesting motherboard unit based on the 68000, and a host of software and hardware support has sprung up from an active and growing little user group.

The Applix motherboard provides for 512K of RAM, dual serial ports, Centronics compatible printer port and a user port featuring eight digital I/O lines with timer, analogue I/O and power supplies.

The expansion bus features virtually all the 68000 signals to enable easy hardware interfacing. It has a Wordstar-like editor in ROM and a full macro assembler.

The video interface gives graphics modes of 320 x 200 pixels in 16 colours and 640 x 200 in four colours; 640 x 350 is installable as a RAM-resident driver.

A comprehensive manual providing progressive assembly and test procedures comes with it.

A full disk operating system is also available. The disk co-processor card can handle 3.5" and 5.25" 80-track and 40-track drives as well as SCSI hard disks. The ZRDOS operating system has been ported to this card, giving access to all CP/M-80 applications software.

A user group newsletter produced by Eric Lindsay provides some solid, informative support and there's a bulletin board. User group meetings are held at the Applix shop every second Saturday of each month, starting between 1.00 and 2.00 pm.

So if 68000's your bag, better contact **Applix, 324 King Georges Rd, Beverly Hills 2209 NSW. (02)758 2688.**

Key to the PC

Keeping your PC secure should you consider i necessary, is now an easy thing according to Hypertec who re cently released the "Hyperlock" an add-on board that they say makes unauthorised access t IBM PCs and compatibles virtu ally impossible.

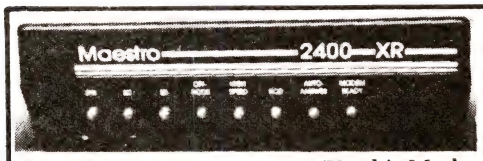
Hyperlock verifies user name and passwords before grantin access to the computer. It ca store up to 50 user names an passwords.

The only way you can get i without a valid user name, say Hypertec, is by physically re moving Hyperlock from inside the PC. This can be restricted us ing keylocks, so a persisten hacker would need to take to th PC with an axe.

Hyperlock is a single half length card that is easily in stalled. It comes with a com pletely configurable sign-o screen — you can display you logo there, or some suitable dir warning!

Hyperlock is for the IBM PC XT and AT or 100% compatibles the PS/2 Model 30, Compa Portable II and III, Compa Deskpro, Deskpro 286 and 38 and costs but $424 rrp (inc. tax Yes, there's a 12-month wa ranty.

Quietly now, contac Hypertec, (02)819 7222.



The MAESTRO 2400XR Here's a fully-featured, Hayes compatible, 1200 and 2400 bps full duplex modem for just **$369 (incl. tax).**

This modem uses the LATEST in DSP Chip Set technology and microprocessor control, bringing you the future TODAY.

Super price on a Super V.22/V.22bis Modem!

Don't Wait! RING NOW! (043) 68 2277, or (043) 68 2278.

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Give Your PC AT/Clone Computer the SMARTC

Get the new XE1287 SmaRTC!

Remember the famed SmartWatch? Well, Xecom Inc. in the States has just released the XE1287, real-time clock with RAM.

This nifty little chip is a direct replacement for the MC146818A found in most AT compatible computers. As some AT owners might have encountered, sometimes the Real Time Clock (RTC) and CMOS RAM in their machine mysteriously 'fails' and resets itself. The time, date and the machine's configuration (what type of hard disk, display adaptor you have, etc.), are all wiped!

What a hassle configuring the system every time you turn it on!

So? Is the XE1287 really worth it?

Well, just like its little brother, the SmaRTC has its own miniature lithium power source which will retain the time of day and its 50 bytes of RAM for 10 years in the absence of power. The chip in fact replaces 16 components in a normal installation!

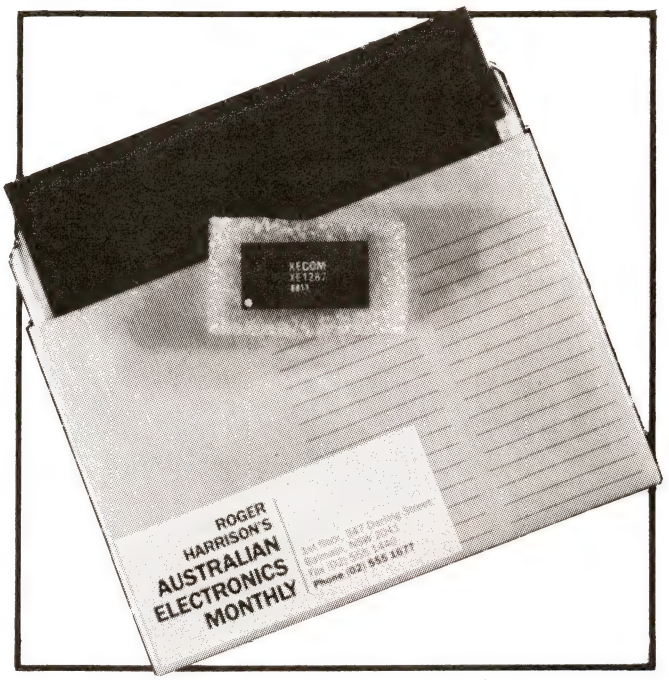
Just like the revolutionary Smartwatch for the PC-XT/Clones, the SmaRTC for the PC-AT/Clones is housed in a piggy-back 24-pin dual in-line package and is as easy to install as an IC! How could you go wrong?

Yes, it really has the SMARTC!

The SmaRTC even compensates for leap years and daylight saving (not applicable in Queensland!). The internal clock can be run in either 12 or 24 hour mode; when in 12 hour mode am or pm indication is shown. Emulation of Intel or Motorola bus timing is also selectable.

JUST $49.95

plus $8.00 delivery



See the Data Sheet in this issue for more details!

To order your XE1287 SmaRTC,

EITHER

Fill in the coupon below and send a cheque or money order to:

AEM SmaRTC Offer,
1st Floor, 347 Darling St
BALMAIN 2041 NSW.

OR

Phone (02)555 1677 and 'pledge your plastic'

As a bonus for purchasers of the XE1287 SmaRTC, Energy Control will despatch a disk with useful utilities for the SmaRTC and your computer.

This offer is being made by Energy Control International P/L and AEM is acting as a clearing house for orders.

OFFER CLOSES 30 SEPTEMBER 1988.

Yes, please send me . . . . XE1287 SmaRTC's at a cost of $49.95 + $8.00 for delivery.

I am paying by ☐ Cheque ☐ Money Order ☐ B/Card ☐ M/Card ☐ Visa.

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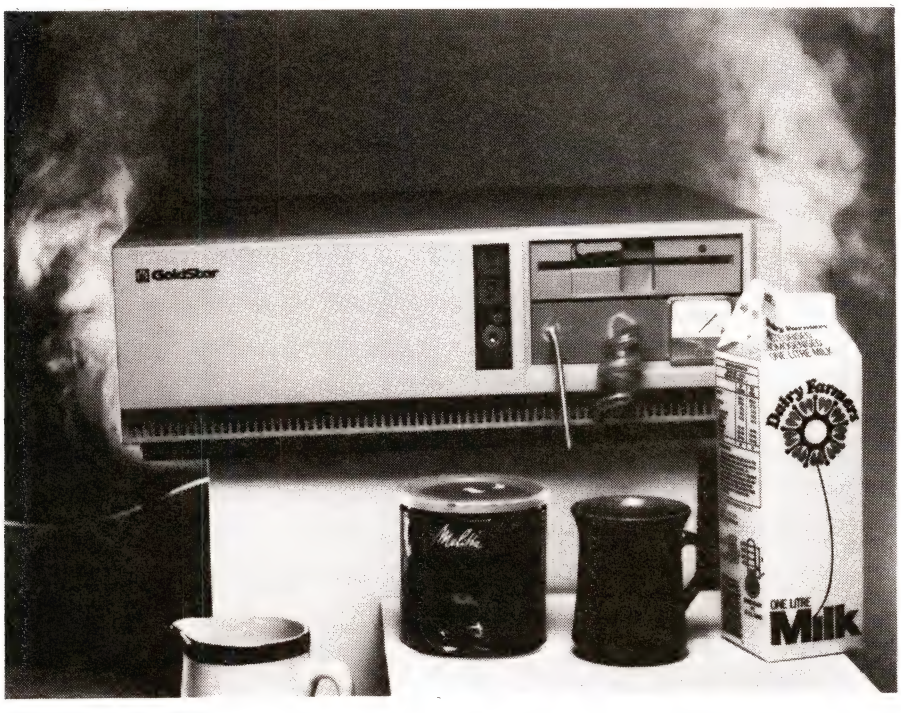
(Orders are despatched to Energy Control within 24 hrs of receipt at AEM. Please allow up to 10 days for delivery)

Goldstar AT-compatible, from Kambrook

Jamye Harrison



What, it does everything AND make your coffee? Well, YES! (Or so our tongue-in-cheek picture would have you believe! Just kidding, folks.)

I MUST ADMIT that, when I first heard that Kambrook, best known as an electrical accessories and houseware specialist — famous for electric kettles and urns, power boards and kitchenware — were releasing a range of IBM-compatible computers I was, to say the least, amused. However, when this AT-compatible arrived on my doorstep, and I eagerly opened the two cartons, I had to wipe the smile from my face.

The machine arrived at a very opportune time for me because I was just completing reviews of two other AT-compatibles sold locally. These were of the "no-frills" variety, made in Taiwan and sold here by electronic retailers in either "bolt-together" or readily-assembled form. As luck would have it, at the same time I also had the opportunity of reviewing a CAD (Computer Aided Drafting) package of software and hardware which included a Compaq 386. Thus I had the fortune of having representative machines from both ends of the market which enabled me to make to make comparisons and place the new machine within some context.

Some background

When reviewing products, especially electronics gear, two things can make the job difficult. Firstly, if the product to be reviewed has no equal in the marketplace or, secondly, if the product has a whole swag of equivalent products. In the case of reviewing MS-DOS computers the latter applies.

With this in mind it would probably be apt for me to mention some things which I found lacking in the many "no-frills" type compatibles around. Primarily, the standard of documentation supplied often leaves a lot to be desired. In fact, some machines I have seen only came with a 20-page booklet which only gives a basic description of the motherboard and location of the major components.

In addition, the level of customer support is also lacking in the market of "no-frills" clones. Obviously, with a computer giant like Compaq or IBM these two drawbacks don't exist, a large percentage of the company's time and money is channelled into producing quality documentation for their products and providing on-going customer support. However, you do end up paying for this.

Where does the Goldstar computer fit into this? Well, it doesn't. What confronted me when I set-up the computer and started using it was not just a computer, but a computer system. Everything was supplied, the monitor, serial port, parallel port, floppy controller *and* documentation of a standard I have rarely encountered in the computing industry. I suppose this is the advantage Goldstar have, by being one of the last companies to release MS-DOS compatible machines they are able to incorporate what others lack. This is certainly what they appear to have done. Hindsight helps.

What did we get?

The system, as it was supplied to me, comprised: a Series 7000 AT-compatible system unit, a 330 mm (13) colour monitor, a 20M hard disk, a 1.2M floppy drive and an ATI EGA Wonder Card installed. The system unit comes with two serial ports and one parallel port, 1M RAM, and a dual floppy disk controller (1.2M or 360K drives, 3.5" or 5.25") all *as standard*. Other specifications include; 8/10 MHz operation, eight expansion I/O slots, external reset and keyboard lock switches. The BIOS in ROM is from Phoenix, widely recognised as the "most compatible" around. It's certainly the most successful by reputation, if not performance.

Goldstar offer a range of graphics adaptors, other than the EGA card supplied. So, you can get a mono and colour card, a 132-column display card or a VGA and Plantronics card.

One thing to keep to the forefront in

your mind during this review is the price of the system. The configuration I have just described retails for $4014. (Well, that's the rrp — the "go price", as they say in the industry, the price for which products really sell, will likely be somewhat lower).

The cabinet, keyboard and monitor housing are "industry standard" buff-grey coloured. The keyboard has the usual operation keys (shift, enter, tab, alt, esc, etc) depicted in a darker colour. The system is warranted for 36 months and Goldstar offer a five year "extended complete cover plan" for service. DOS 3.21 is supplied, along with GW-BASIC. Two manuals are supplied, an "Operations Manual and MS-DOS User's Guide", the other titled "GW-BASIC Interpreter". The standard of this manuals is excellent. They come in sturdy ring-binder folders, are well laid-out and have comprehensive indexes. Better still, they're written in *English*

The checkout

Whenever I review a PC-compatible computer, two tests are always paramount in my mind. One: is the machine both totally compatible and easy to use with current software?; and two: how easy is it to add extra pieces of equipment to the system?

The task I usually use to test for software compatibility and reliability is to install and use AutoCAD on the machine, judging how easy it is to install the software and peripherals and how well the machine performs with the software, (how fast it runs, etc). On the Goldstar AT there proved to be no problems in installing the software or operating it. Top marks here.

Installing a second hard disk is the other test I use to evaluate a machine. This is because it demonstrates to me how difficult it is to implement new equipment in the system, and gives me a chance to get inside the 'guts' of the machine for a poke around at its internal organs. From experience, installing a hard disk has proven to be a task fraught with a number of hidden difficulties, both with the hardware and the software.

So, how does it stand up internally? Well, this is where the Goldstar really shines. Opening the case is rather like opening up one of the older style IBM-XTs. i.e: it has a slide-off metal case, not a flip top. This type of case, I find, is preferable in a number of circumstances. Firstly, in my experience flip-top cases, while providing easy and quick access to the machine, are not on the whole as rigid. Having an older style, slide-on/slide-off case provides for greater reliability as the unit isn't as susceptible to twisting and warping of the case when moving the machine. Add-in boards shuffle out of their sockets insidiously, creating an intermittent fault that inevitably pops up when the greatest possible inconvenience will be caused.

A slide-off case is an inconvenience if you need to constantly install and remove equipment inside the unit, but these computers aren't targeted at that sort of market, which the bolt-togethers are, and removing the case to install add-ons occasionally is only a minor inconvenience. The case, incidentally, measures 460 x 400 x 150 mm.

Inside the machine, its internal construction and architecture is nothing short of top quality. In fact it was not dissimilar to the, up till now, unparalleled engineering of Compaq's computers. Every separate assembly of the system is properly grounded, including the hard disk and floppy drive cage. The inner shell is a rigid metal assembly while still being relatively lightweight.

The motherboard has six 16-bit (AT-type) expansion sockets for add-in cards, and two 8-bit (XT-type) expansion slots. It has a battery-backed real-time clock (that works!) and includes the mandatory socket for a maths coprocessor (very handy with programs like AutoCAD). It uses the ubiquitous Chips & Technologies chip set.

Installing another hard disk proved to be relatively painless. The hard disk controller card had provision for the second drive and the only problem posed was in obtaining the appropriate cable. It is worth noting here that the computer's floppy controller is *on-board*, only the hard disk controller is an add-in card.

After putting the case back on the naked computer I booted-up the machine again and reconfigured the CMOS RAM to allow for two 20M hard drives. I then attempted to format the new hard disk using both FDISK and FORMAT, and neither of these would work; very strange indeed.

This problem was solved by 'phoning Goldstar and asking what I had done wrong. I spoke to their National Marketing Manager and their Office Automation Manager, both of whom *actually* knew about the computers they were selling and had already tried and tested the very same things I had done in reviewing the system.

The solution was simple, I needed to run another program to prepare the hard disk first, before doing any low-level or high-level formatting.

Operation

Overall, the Goldstar 7000 could hardly be faulted in use. However, few minor weaknesses *and strengths* do need to be pointed out.

The 101-key keyboard supplied with the machine was a bit 'clunky' for my liking, it had a rather heavy feel, although not enough to become a major worry. Keyboards, on the whole, are more or less a matter of taste.

The ATI EGA Wonder Card supplied worked well in its normal EGA mode. However, I found that after software switching it to emulate a CGA card, some CGA-dependant games did not work, although I have never found a multi-function add-in video card which did operate in all modes without fault. Par for the course, I guess.

The colour monitor is excellent, especially for the price. It is an Enhanced EGA type and has a 'text' switch which swaps between colour mode and amber monochrome mode. This proved to be helpful with wordprocessing software and text editors which don't accommodate colour video boards; much easier on

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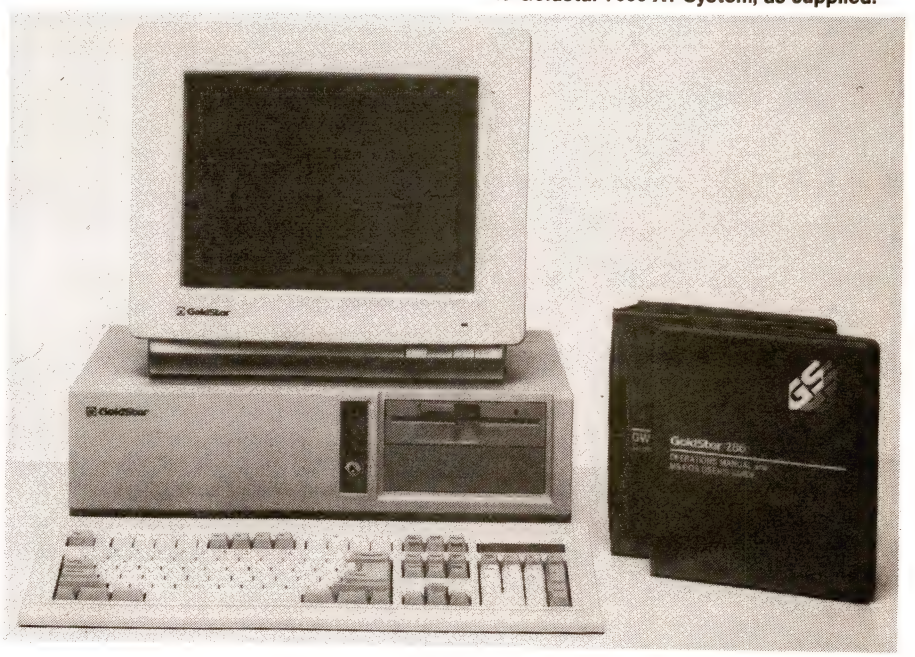
The Goldstar 7000 AT System, as supplied.



in the FM broadcast system, where high frequency response is boosted at the transmitter and rolled-off at the receiver. The standard VHS system employs a scheme known as linear emphasis, providing an improved signal-to-noise (S/N) ratio above a given input level. The SVHS system employs "non-linear sub-emphasis" which improves the S/N ratio across the signal range. Figure 4 illustrates.

To maintain the high quality achieved with the SVHS system, a new tape formulation has been developed. While still a ferric oxide formulation, finer magnetic particles are used — around 0.18 µm long, compared to the 0.24 µm-long particles on hi-fi VHS tape. New video head technology has also been introduced for the same reasons, the camcorders and VCRs now being able to deliver on a 12.7 mm (half-inch) tape what required 25.4 mm (one-inch) tape running at higher speeds only a few years ago. The new SVHS tapes have a special identification hole in the cassette so that the recorders can "recognise" that an SVHS tape is being used.

Receivers have been developed especially for use with SVHS systems having, apart from the required S-terminal input, a higher resolution screen with a dot or stripe mask finer than is fitted to the current crop of receivers in order to take advantage of the resolution SVHS offers.

Why SVHS will be a new revolution in video

In terms of quality, the VCR in the past has been the weak link. It could not reproduce a recorded TV picture as good as that possible from a TV in good adjustment, regardless of the TV standard or video format. The TV station picture, given good reception, looked a lot better than the VCR playback. SVHS now reverses this situation with a margin to spare.

For viewers in the PAL TV parts of the world, the plusses from SVHS are instant with an SVHS VCR. The much higher quality possible with PAL format TV means that the professional quality replay signal from a SVHS VCR equals or betters the TV station signal as they would be clean of the normal hash which comes with most radiated TV signals in city areas. The improvement gained is even more dramatic on a receiver having an S-terminal.

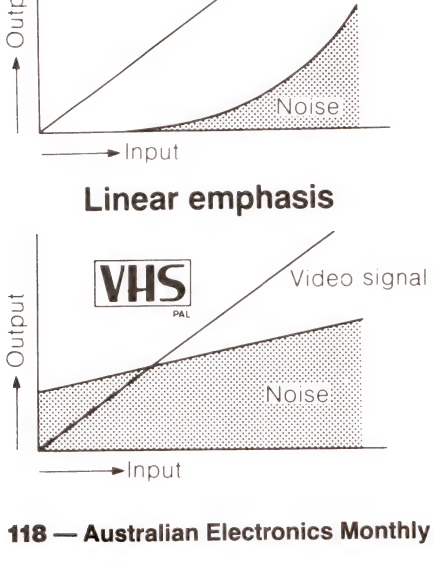
We have witnessed the misfortunes of a dual video format in recent times. The universal acceptance of VHS is as significant as the recognition of 35 mm standard format was in photography. Both are imaging media and with the advent of SVHS Euro System there will be for the first time in video, a format that will probably cover 70 per cent of the world's population of TV/video viewers.

This means that a Videomovie user with a SVHS Euro System Camcorder can shoot and replay *on any SVHS VCR*, from Lisbon to Vladivostok, from Narvik to Salerno.

Unfortunately, they will still be "video illiterate" in the Americas and Japan. No doubt the wizards of chippery are already CADing and masking substrates to bring the conversion from one TV format to another. The average traveller wishes to show their home format video wherever they go in the world.

It is ironical that Japan, which has called all the shots in video for the past decade, is likely to be in the minority TV format area as PAL/SECAM does a VHS-over-Beta type of format victory on a world scale. The difference is that TV is politically regional. SVHS video provides the watershed for this dilemma; video is everyperson's private TV station.

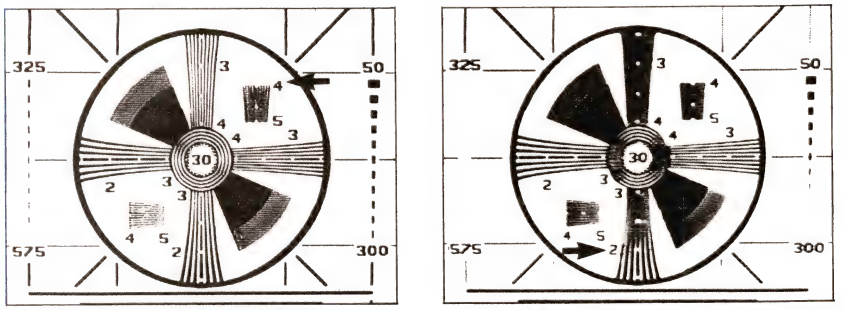
Figure 4. The Super VHS system employs non-linear sub-emphasis to improve the signal-to-noise ratio on the broader bandwidth signal.



HORIZONTAL RESOLUTION

This refers to the number of vertical lines that can be resolved across the screen; it should not be confused with the number of scan lines that make up the picture.

To date, broadcast video, irrespective of the TV system, had a horizontal resolution better than could be achieved on domestic VCRs. For our PAL system, broadcast video has a horizontal resolution standard of 330 lines. Standard VHS has a resolution of only 240 lines. Super VHS achieves a horizontal resolution in excess of 400 lines, comfortably exceeding broadcast standard.



Over **400** lines can be counted with **S-VHS**.

Only **240** lines can be counted with conventional **VHS**.

Test patterns comparing the resolution of Super VHS (left) and VHS (right).

Comparisons

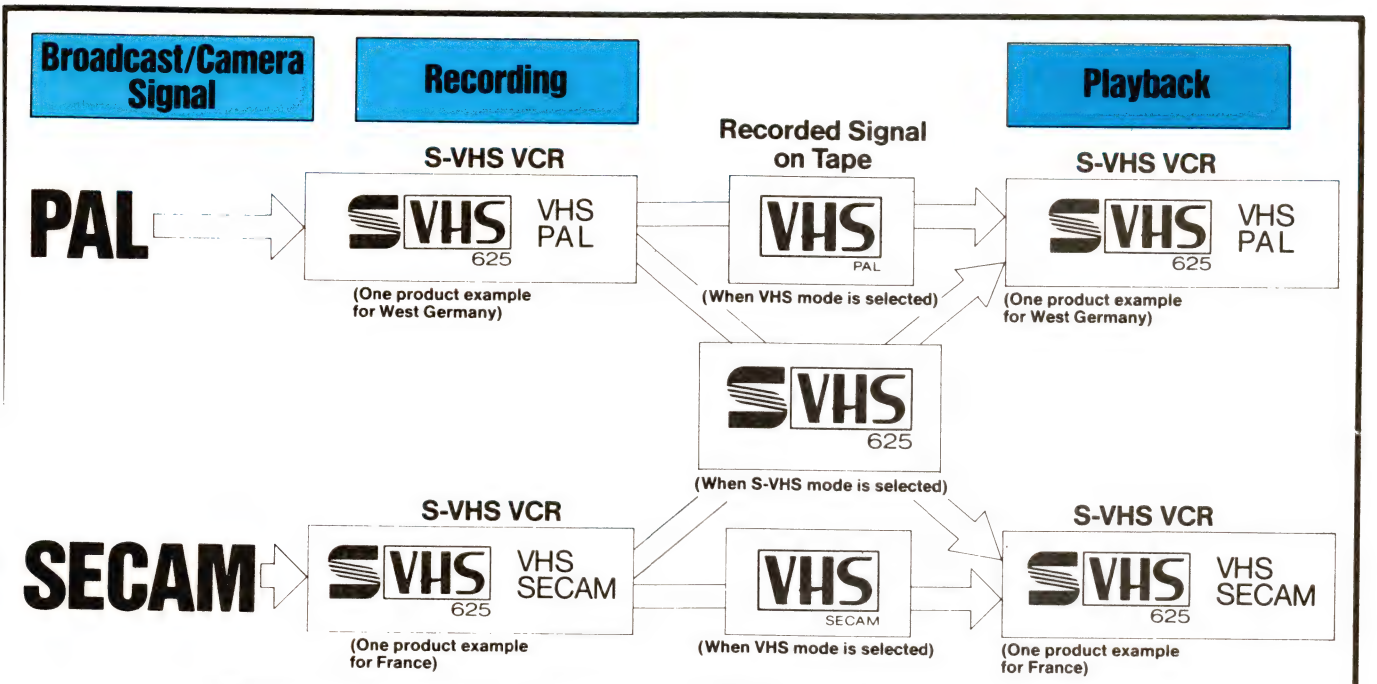
When Panasonic was de-Nationalised this year the press were treated to a demonstration of SVHS in NTSC using one of the new Super TVs as a monitor. They had a side-by-side comparison with the same taped material on standard VHS. It was very impressive and drew comments of praise similar to those comments voiced at the Chicago CES in the US last year.

The best way I can describe the comparison is to say that the mandatory "beaut blond" had lovely locks on VHS on SVHS you could count each hair! As for the colour, the comparison between VHS and SVHS would be likened to "before" and "after" that miracle shampoo.

The later demonstrations of the PAL version, by JVC and Panasonic, simply reinforced that view, although the difference between VHS and SVHS in PAL was not, perhaps as *dramatic* as it was with NTSC. Nevertheless, the sharpness, detail and colour clarity in SVHS are remarkable.

We were also treated to a demonstration of a segment recorded first in standard play (SP) then in long play (LP) – and I can tell you that it was only because they told us that we knew the difference. SVHS seems to remove the degradation noticeable with LP recording.

As SVHS results in quality better than the average TV can resolve, even in PAL, perhaps the cost conscious consumer will resort to an SVHS VCR used in long play with three hour tapes doing six hours, etc. Apart from tape cost reduction, the 24 tape giving eight hours on LP is a mighty time shifter for long weekend absences.



Showing the cross-compatibility between PAL and SECAM formats in the Super VHS Euro System.

JVC showed clips from some recent movies — Top Gun and Beverly Hills Cop II. You could see the beads of sweat on the actors' brows, a car windscreen shatter into thousands of fragments in a orang, etc.

Today's media reporter

Panasonic and JVC are talking-up SVHS as the next electronic news gathering (ENG) 'tool' of the media reporter. There was a time when you could not put any tape recording to air unless it was recorded on a "Gumnut Approved" Byer tape recorder (I'm talking audio here). Kerbside interviews were not possible when TV started. That has all changed since. Camera-sized cassette recorders now exceed in performance the best of the old approved reel-to-reel machines in large suitcases and on-the-shoulder video cameras for doorstop interviews on the run.

Now we have the advent of SVHS camcorders with 400+ lines resolution, exceeding accepted professional video standards. But they will cost in the region of $5000 compared to current ENG kits of $50 000-$100 000, and weights that require a golfcart to carry the backup gear.

Will we see in future a cluster of handworn camcorders thrust at the VIP, just as we now see mikes and cassette recorders? Why not? The latest small camcorders are fully auto-operated, weigh slightly over 1 kg and are worn on the hand like a glove.

Reporters for print, radio, TV, media could well make the SVHS camcorder their all-purpose electronic notepad. A newspaper reporter not remembering the smile on the face of the politician could be trapped by his tape recorder into a false report. A radio reporter who happened to be first at a great visual story could give it TV cover as well.

There have been many work practices that have held back the march of technology to the detriment of public interest. It is to be hoped that if the SVHS cap fits professional standards of ENG it will be worn immediately.

Where is it going?

Panasonic has linked SVHS with "home theatre" entertainment and suggest that as video libraries go SVHS they could also go LP. You would be able to get one of those 10 hr TV blockbusters, minus all those commercials and station perks, in a single 240 cassette.

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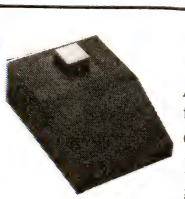
JVC's first Super VHS VCR, the HR-S5000 is a fully-featured unit boasting hi-fi audio and a sophisticated remote control; available shortly.

STATIC Awareness



Make your personnel aware of static. Put a **Voyager PVT-300 Personal Voltage Tester** where they work.

All you do is walk up, touch the top terminal with your finger and the PVT-300 gives an instant voltage reading on its 3½ digit LED display – up to 9.99 kV.

Demonstrate personal static pickup. Check the effectiveness of grounding methods.

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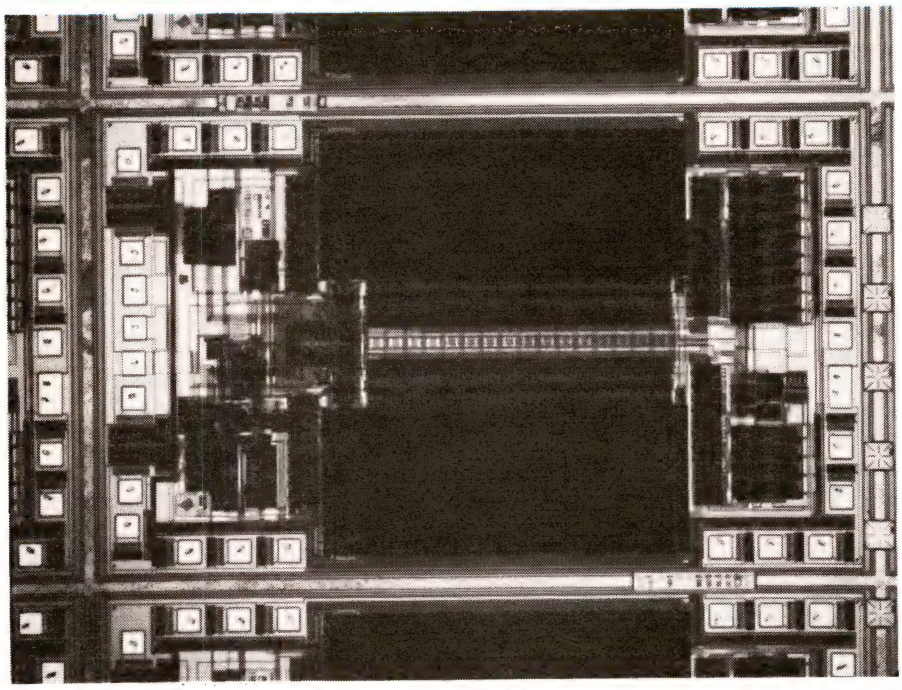
Fax: (02)750 5224



Fast static RAM features Clear facility

Memory devices need to keep pace with the processors they serve, and with today's super-fast processors, that's a cracking pace!

VLSI Technology in California's Silicon Valley (where else?) has announced the release of a 4K static RAM, VT20C50, boasting a 15 nanosecond access time and a memory set, or clear, function that allows memory cells to be set to logic zero within two cycles.

The Clear capability of the 1K x 4 SRAM minimises software development by eliminating the need for a software reset. It is particularly useful for cache memories at power-on or system reset, according to VLSI. This capability is especially useful for rapid "flushing" an entire cache memory. As it can operate with clock speeds to 60 MHz, the VT20C50 can keep pace with the newly emerging higher clock rate microprocessors, says VLSI's Strategic Marketing manager, Dick Eiler.

The VT20C50 also features separate inputs and outputs which eliminates the need to multiplex data in and out, useful in "pipelining" applications. VLSI see the device having applications in image processing, digital signal processing and automatic test equipment.

You can obtain the device in speed ratings of 15, 20 and 25 ns and in several surface-mount packages as well as a 300-mil, 24-pin DIL package.

VLSI Technology is represented in Australia by **Energy Control International P/L. (07)376 3286.**

AWA sets up ASIC technology centres

AWA Microelectronics' first ASIC Technology Centre was opened on 3rd August at British Aerospace Australia's Adelaide plant. A collaborative enterprise by British Aerospace Australia (BAeA) and AWA Limited, it is designed to link state-of-the-art microelectronics design facilities at BAeA and silicon manufacturing facilities at AWA's soon to be commissioned Homebush Bay plant in Sydney.

BAeA will be using AWA's ASIC design technology to develop chips for their own use as well as for clients. The designs will then be passed back to AWA for manufacture. The designs are not "hard copy" however, but software. This will initially be passed back to AWA's Sydney plant by landline, later by satellite using the M-SAT satellite link.

Turnaround times from chip design to prototype chip production are expected to be between four and six weeks.

BAeA's ASIC Technology Centre is based on three Apollo workstations running a Mentor Graphics software suite and utilises the 6-inch silicon wafer fabrication facility at AWA in Sydney.

AWA Microelectronics is now the only Australian company to design and manufacture state-of-the-art ASICs. The market for these versatile custom-designed chips is growing at some 40% a year, we're told.

AWA is targetting four major targets with its move into ASICs: telecommunications, defence and aerospace, medical electronics and information technology.

Lower component and manufacturing costs are major advantages of electronic systems which use custom-made ASIC chips. Systems using ASICs are easier to design and manufacture, cheaper to produce and more versatile than those using off-the-shelf chips.

Other AWA Microelectronics ASIC Technology Centres are planned in the near future. The next ATC will be opened in Melbourne very shortly, with another announcement expected shortly for Brisbane.

Transputer to fly in next UOSAT spacecraft

The next satellite to be flown by the University of Surrey, UOSAT III, will carry an Inmos Transputer processor aboard.

The UOSAT I and II are "educational" satellites that carry "experiments" on board that are used by schools throughout the world, incorporated in science curricula.

Transmitting data on 145.825 MHz, in the amateur two metre band, the spacecraft provide satellite engineering data, store-and-forward messages and bulletins from the University of Surrey ground station, and whole-orbit data collected by various sensors on board. (See *Satellites in the School Curriculum*, AEM, Oct. 1987, p.12). Relatively simple equipment may be used to receive the satellites.

UOSAT III is due to be launched in the US later this year by a Delta rocket. The Transputer is very radiation tolerant it turns out and, apparently, the European Space Agency is encouraging the University of Surrey team to test bed the device in their space hardware to see if it's suitable for civilian satellite use.

Semiconductor catalogue

The latest semiconductor catalogue from Standard Microsystems Corporation contains data on their lines of data communications products, baud rate generators, display products, floppy and hard disk controllers, keyboard encoders, microprocessor products and shift registers.

Standard Microsystems specialises in MOS LSI and VLSI circuits and is an acknowledged technology leader in dense, high speed, low power, n

channel, single-supply devices. The company has developed MOS second-source equivalents to many industry standard NMOS devices. The company is now a leader in the design of application specific ICs (ASICs).

The new catalogue is available from the Standard Microsystems Corporation distributor, **Email Electronics, 15-17 Hume St, Huntingdale 3166 Vic. (03)544 8244.**

Really rapid ROM

Integrated Silicon Design of Adelaide has announced local availability for Gigabit Logic's 512 x 8-bit mask-programmable ROM, the 14GM048, which boasts data access in 1.5 nanoseconds maximum, three to four times faster than any commercial ECL equivalent, the company says.

The device has a 500 ns output-enable access time which permits direct address decoding with increasing overall memory access time, we're told. The 14GM048 works with standard –5.2 V and –2.0 V ECL power supplies and is ECL I/O compatible.

A second version, the 14GD048, features a user programmable output-enable decoder on-chip to allow ROM expansion up to 32K without the need for external decoding logic.

Gigabit Logic say that the 1.5 ns address access time makes the ROM ideal for use in a variety of high speed systems, such as fast lookup arithmetic logic operations or code conversion, random logic in critical timing situations and digital signal processing.

Apparently, production quantity deliveries were available from July. Contact **Integrated Silicon Design, PO Box 99, Rundle Mall 5000 S.A.**

New AD converter offers 1 MHz throughput

A new 10-bit analogue-digital converter from Datel solves critical circuit layout and thermal problems by combining both a tracking sample/hold amp and the AD converter in one miniature 32-pin hybrid ceramic package.

Available in two models – ADS-115 (for commercial temp range) and ADS-116 (military temp. range). They offer true 10-bit performance with conversion rates up to one million samples per second.

Datel say the devices are ideal for single or multi-channel applications needing data points from a signal of rich spectral content. Typical usage would include high speed data acquisition and process control systems, DSP, imaging, transient analysis, communications signal processors, and analysers for acoustic, seismic, vibration and resonance analysis applications.

Both models are fabricated using a proprietary gate array which handles all internal timing. TTL/CMOS compatible data and overrange outputs may be tri-state gated in both byte-wide and full word widths. Data outputs may be logically complemented. Both models consume less than 2.8 watts from ±5 V and ±15 V supplies.

Full power input bandwidth is quoted as 60 kHz (at 10 V pk-pk) with typical distortion of –60 dB. And they're keenly priced at a store-stealing $895 in one-off quantities. Further details from **Elmeasco Instruments P/L, PO Box 623, Ringwood 3134 Vic.**

National R&D centre dedicated to Fairchild pioneers

National Semiconductor's recently completed research centre located at the company's Silicon Valley head office has been dedicated as the "Fairchild Research Centre" to honour the efforts and creativity of all Fairchild employees from 1957 to 1987 who pioneered the semiconductor industry. National took over Fairchild late last year.

Special guests at the dedication included the "Fairchild 8" – Gordon Moore, Sheldon Roberts, Eugene Kleiner, Robert Noyce, Victor Grinich, Julius Blank, Jean Hoerni and Jay Last, along with other prominent early researchers such as David Allison and Robert Widlar.

National's president and CEO, Charles Sporck, lauded Fairchild as "the grandaddy of all semiconductor companies." Sporck himself was manufacturing head at Fairchild prior to being named president of national Semiconductor 21 years ago.

Sporck said, "The roots of Silicon valley clearly are traceable to the founding of Fairchild and the technology developments which were achieved there. With its technology and talented people, Fairchild has been a remarkable 'fit' with National," referring to the acquisition of Fairchild which was completed in October last year. Sporck went to say that ". . . Fairchild's spirit lives on with national, and we want its name to endure as well."

The 146 000 square foot, two-storey building includes a 25 000 sq-ft clean room and will house a total of 600 people in future. An exhibit in the centre traces technological achievements, including the evolution of the digital computer from vacuum tubes to the computer-on-a-chip; the image-sensing evolution from transistor punched-card readers to CCD video camera "eyes"; a series of silicon wafers from early 5/8-inch to current 8-inch wafers; the development of computer memory to modern-day ICs; and a history of the IC beginning with the origin of the logic circuit in 1961. All items were donated by National employees.

New high performance CMOS Z80 flies at 10 MHz

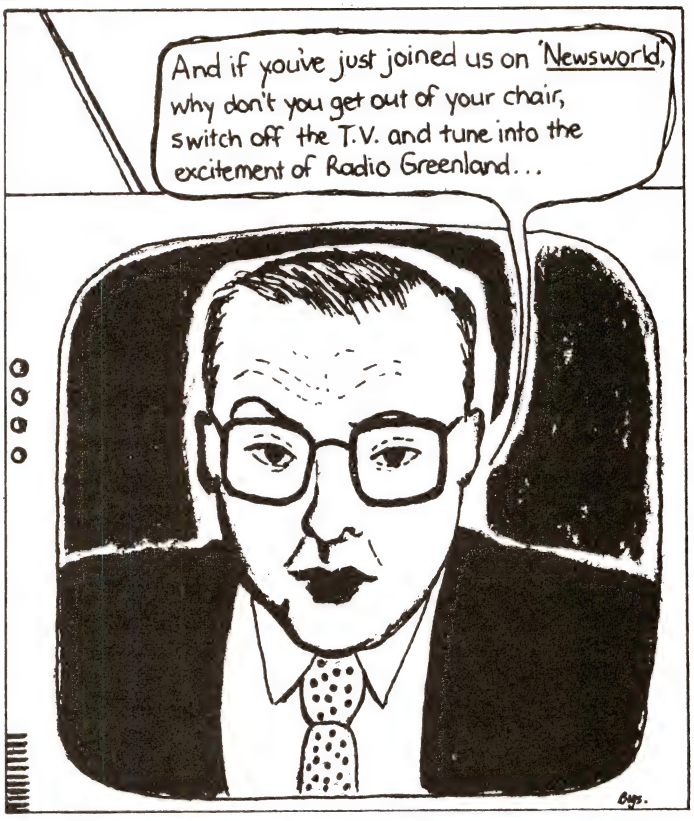
Zilog's recently unveiled Z84C01 is a 10 MHz 8-bit CMOS microprocessor sporting an on-chip clock generator controller that accepts either a crystal or TTL-compatible clock source inputs.

The company claims the Z48C01 is completely compatible with standard Z80 application software and interfacing requirements, and offers all of the features found on the Z84C00 CMOS Z80 chip. Power consumption is typically 35 mA when operating and less than half a microamp in standby.

The device accommodates four kinds of operating modes in connection with clock generation: RUN mode, IDLE1/2 modes and STOP mode. These are controlled through two mode-select pins, providing complete control over the CPU, oscillator and clock operations.

The Z84C01 operates from a single 5 V supply and comes in a 44-pin plastic leaded chip carrier (PLCC) package. More details can be obtained from **The George Brown Group Marketing Division, 456 Spencer St, West Melbourne 3003 Vic. (03)329 7500.** ▷

▷ from page 110.


And if you've just joined us on 'Newsworld,
why don't you get out of your chair,
switch off the T.V. and tune into the
excitement of Radio Greenland...

and the Antarctic and the Americas, and maybe Europe would come sneaking the other way round, and later the Far east and Africa, you never knew what.

He'd close his eyes, or gaze hypnotised at the speaker, and he'd listen to them and talk to them, voices in the night, his night that is, with the moon shining into the den through the great beam antenna that rose from the lawn outside. And his long day at the office and the university with the students who were so knowledgeable, and his own free-floating anxieties and somatic symptoms, and the indefinable problem that was Judy, would cease to exist for a while.

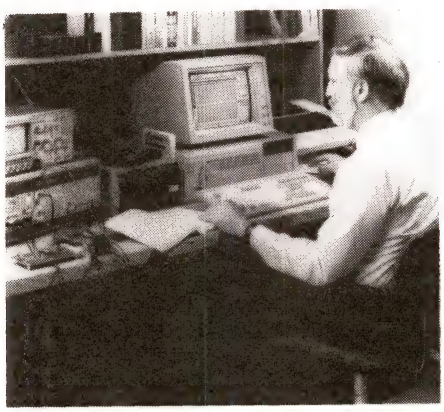
While it was his night in New South Wales, it was yesterday in Oslo and Hil was getting ready to shovel the snow from in front of the garage so he could go to work, and in California it was late yesterday afternoon and Tommy had just arrived home from a rainy day at the lab, and Toshi in Kyoto had just finished dinner.

And then later, Phil would talk to him from his car speeding through the Malaysian jungles to pick up Margaret from her French lesson in Penang, and Phil would lower the car window and let him hear the street noises of Penang even as he sat in his den in the house in Sydney while the guy next door was listening to *Newsworld* on Channel 7, for crying out loud, and they ask "what do we talk about?"

We don't talk about a damn thing and it's *terrific!*

(With apologies to Ernest Lehman)

From the ACSnet UNIX mailing list AR-LIST, by Scott VK2JAG.



Speedy AD converter tests

Tektronix has introduced a test system that evaluates AD converters in a fraction of a second, they say. The PTS101 is a turnkey system that provides complete test data for such important parameters as resolution, signal-to-noise ratio and differential non-linearity.

The PTS101 replaces "rack and stack" systems that often provide unprocessed data and incomplete information when testing AD converters. It has been designed for system engineers evaluating the dynamic performance of AD converters used in such applications as high-speed data acquisition, image processing, acoustic signal processing and medical X-ray digitizing.

The system is microprocessor controlled using the Intel 80386 and 80387. The PTS101 also features a mouse-driven, windowed software package for easy control of measurement sequences. Most measurements can be made within a fraction of a second.

The instrument can test devices with sampling rates as high as 20 megasamples per second and resolution up to 10 bits. External generators and acquisition units can be used to test higher spec devices via a controller and GPIB ports.

More details from **Tektronix Australia Pty Ltd, 80 Waterloo Rd, North Ryde 2113 NSW. (02)888 7066.**

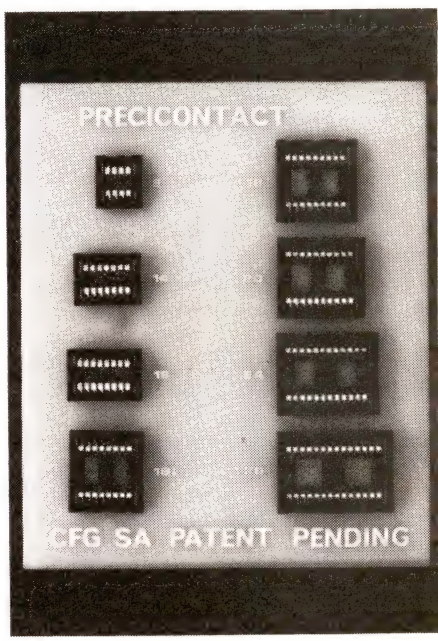
Sockets for surface mounted ICs

It had to come! Utiliux is introducing to the Australian market "the first truly surface mount socket for all SO-type surface mount integrated circuits."

Manufactured by Precicontact of Switzerland, the new SMD socket is available with SM contacts and is compatible with all SMD integrated circuits in SO packaging, following the IEC standards.

They feature zero insertion force, a contact force of 60 grams and are made from high temperature plastic compatible with vapour phase soldering techniques.

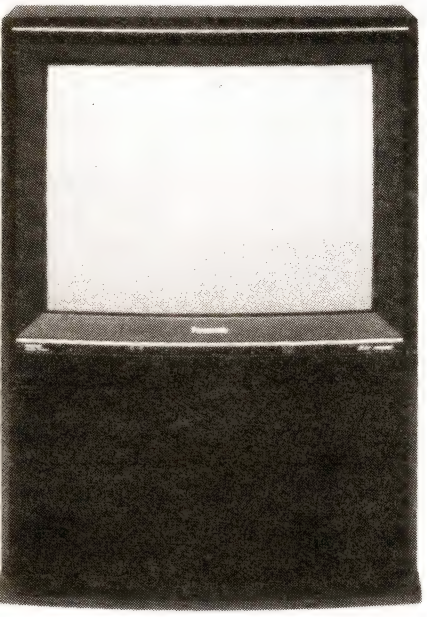
Full details are available from **Utilux Electronics Division, 14 Commercial Rd, Kingsgrove 2208 NSW. (02)50 0155.**



▷ from page 119

Growth of SVHS equipment sales is expected to be strong once the hardware/software Catch 22 is past; the software companies are reluctant to release many titles on what is, to them, yet another format until there's more hardware around, but hardware sales will be slow until more titles are released on SVHS.

A JVC spokesman said they expected that SVHS would represent about 20% of the market in Japan by the end of 1989. Sales of new TV receivers is very buoyant in Australia at present, particularly for large-screen sets. This sets the stage for ready and rapid acceptance of Super VHS here.



Large screen TV receivers will be the first released with S-terminal connectors for Super VHS. Panasonic will release this fully-featured remote control 33" model here shortly.

Panasonic's Super VHS camcorder, the NV-MS1 is a "Super" version of their M-7 camcorder. It takes a full-size cassette and will probably be available here in a few months. C-format Super VHS camcorders will not be available for some time, although JVC showed a prototype here in June.

Video has to be the fastest moving achievement of man, and womankind. The advent of SVHS carries Video into IMAGING "hyperspace". The impact on a lot of very expensive and heavy ENG equipment will be catastrophic in the near future. It is so outstanding as a performer compared to the rest of the video field that a decision on what to back from now is not required.

If you are going forward in video, either pro or consumer, SVHS is the obvious way; you'll have a respite from sudden obsolescence for a while at least. Consumers will have to count their pennies, at least at first, but under-equipped video pros will suddenly find they can afford the best.

THE COST

The cost of "going Super" all the way — Super TV with S-terminal, SVHS VCR and SVHS camcorder, will be an expensive exercise, but not outrageously so when you compare it to getting the top of the line in standard video/TV equipment now. The VCRs will be a few hundred dollars more than current top-range models, camcorders ditto; the SVHS tapes are expected to be around 1.5 to two times the cost of current VHS hi-fi tapes. The receivers to be released are all large-screen models to take advantage of the greater resolution, and you'll be paying around $2000-$2500 and upwards for them.

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from page 117.

the eyes! Overall, the image is sharp and well-focussed, with no evidence of distortion, particularly around the edges, a fault with a lot of monitors. Colour is clean and bright.

As I mentioned earlier, the Goldstar AT is software switchable to operate at either 8 or 10 MHz clock rate. Most computers having a turbo mode commence operation in the slower mode upon startup. Not the Goldstar though! When configuring the CMOS RAM *you* get to decide which speed you want the machine to power up in. Not bad! At top speed it's just slightly slower than a 12 MHz machine with which I compared it running the same software. The difference is *fractional* however, to the 20% you might think. Clock speed and program execution times are not directly related functions.

Conclusion

If you were a mad hobbyist, who catches only about two hours sleep a night, is addicted to coffee and usually can't find your computer on the workbench anyway, I would not suggest that you buy a Goldstar computer system. However, for the computer enthusiast, a not-so-mad hobbyist, schools, the small or even the large business, I would have no hesitation in recommending the Series 7000 Goldstar AT-compatible computer.

It is apparent to me that Goldstar are not just marketing "another product". It is clear, especially to somebody with considerable exposure to a wide range of computers, that attention to detail and design has been kept well at the forefront in the presentation of the new range of computers, from the perfectly matching EGA colour monitor and computer case to the small things like the quality C&K key lock for the keyboard, detail and design virtually knock you off your chair.

I have only seen preliminary price lists, and have spoken with people both inside, and outside Goldstar about future products and developments. From what I have seen and heard Goldstar will certainly be a force to reckoned with by computing giants such as NEC, IBM and Compaq. I have also caught rumour of more products (other than the XT and AT computers); soon to be released by Goldstar are a number of other computing and other such gear. Judging from reports so far, it would pay to keep your eyes peeled.

With Goldstar, you're getting Rolls Royce performance and quality on a budget bordering on Mini Moke proportions.

Review equipment kindly supplied by Goldstar Distributing Co, 44-60 Fenton St, Huntingdale 3166 Vic. (03)543 2200.

National Semiconductor

LM383/LM383A 7 Watt Audio Power Amplifier

General Description

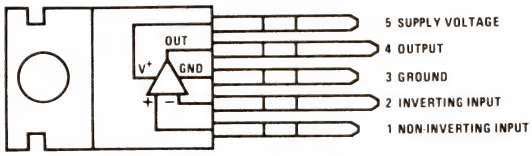
The LM383 is a cost effective, high power amplifier suited for automotive applications. High current capability (3.5A) enables the device to drive low impedance loads with low distortion. The LM383 is current limited and thermally protected. High voltage protection is available (LM383A) which enables the amplifier to withstand 40V transients on its supply. The LM383 comes in a 5-pin TO-220 package.

Features

- High peak current capability (3.5A)
- Large output voltage swing
- Externally programmable gain
- Wide supply voltage range (5V-20V)
- Few external parts required
- Low distortion
- High input impedance
- No turn-on transients
- High voltage protection available (LM383A)
- Low noise
- AC short circuit protected

Connection Diagram

Plastic Package

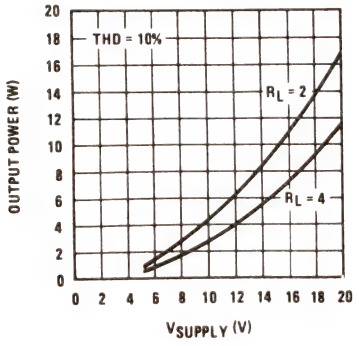


Order Number LM383T or LM383AT

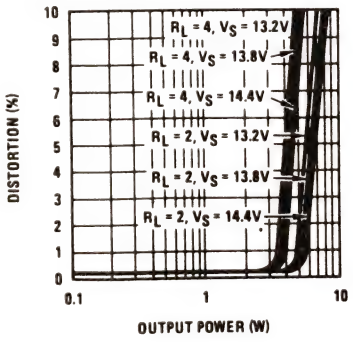
Absolute Maximum Ratings

Peak Supply Voltage (50 ms)	
LM383A (Note 2)	40V
LM383	25V
Operating Supply Voltage	20V
Output Current	
Repetitive	3.5A
Non-repetitive	4.5A
Input Voltage	±0.5V
Power Dissipation (Note 3)	15W
Operating Temperature	0°C to +70°C
Storage Temperature	−60°C to +150°C
Lead Temperature (Soldering, 10 seconds)	300°C

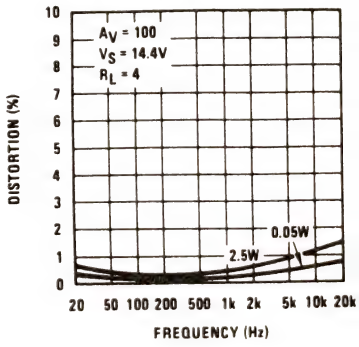
Output Power vs Supply Voltage



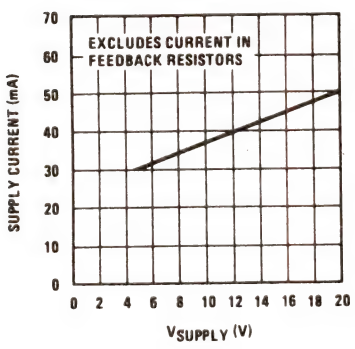
Distortion vs Output Power



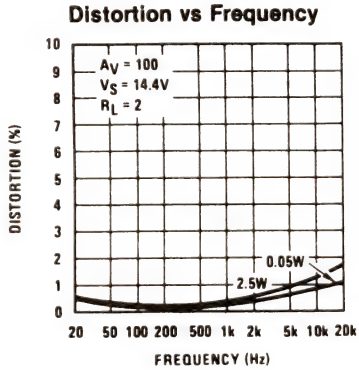
Distortion vs Frequency



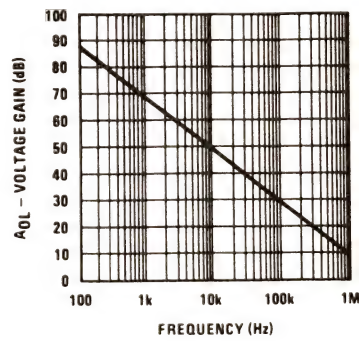
Supply Current vs Supply Voltage



Distortion vs Frequency



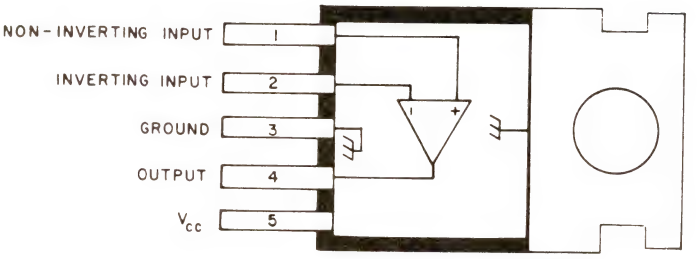
Open Loop Gain vs Frequency



ULN-3701Z / TDA2002
5 TO 10-WATT AUDIO POWER AMPLIFIER

FEATURES

- Low External Parts Count
- Low Distortion
- Class B Operation
- Short-Circuit Protected
- Thermal Overload Protected
- Low Noise
- High Output-Voltage Swing
- TO-220 Style Package
- Direct Replacement for LM383 and CA2002



DESIGNED specifically to drive low-impedance loads down to 1.6 Ω, the Type ULN-3701Z / TDA2002 audio power amplifier is ideal for automotive radio, tape player, and CB applications.

It can deliver 5 W to 10 W of audio in the single-ended mode. Operating in the extremely harsh automotive environment, this device is capable of withstanding high ambient temperatures, output overloads, and repeated power supply transient voltages without damage.

The Type ULN-3701Z/TDA2002 amplifier is rated for continuous operation with supply voltages of up to 18 V. With the application of increased voltages (to 28 V, maximum), a high-voltage protective circuit becomes operative, disabling the device. Devices without this internal high-voltage shutdown are available as Type ULN-3702Z/TDA2008 and are recommended for use where more than 10 W of audio power is required with higher impedance loads and supply voltages to 28 V. In all other respects, Types ULN-3701Z and ULN-3702Z are identical.

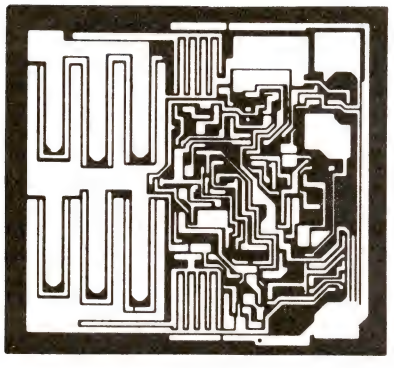
Type ULN-3701Z/TDA2002 is supplied in a modified 5-lead JEDEC Style TO-220 plastic package. The heat-sink tab is at ground potential; no insulation is required.

Lead configurations for vertical mounting (ULN-3701V) and for horizontal mounting (ULN-3701H) are available. Parts are branded with a partial Sprague Electric part number (ULN3701) and the basic Pro-Electron marking (TDA2002) ▷

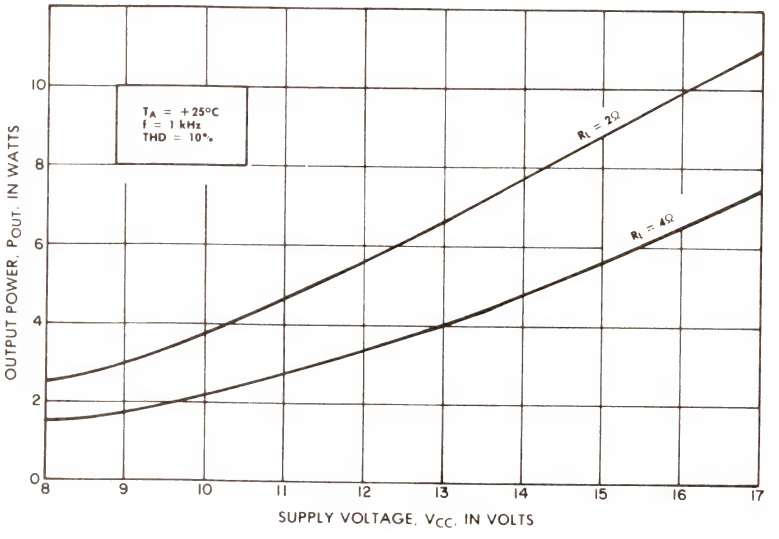
ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V_{CC}	28 V*
Peak Supply Voltage (50 ms)	40 V*
Peak Output Current, I_{OUT}	3.5 A
Non-Repetitive Peak Output Current	4.5 A
Operating Temperature Range, T_A	−20°C to +85°C
Storage Temperature Range, T_S	−40°C to +150°C

*Internal high-voltage shutdown above 18 V.

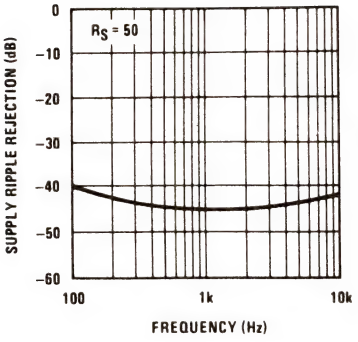


TYPICAL OUTPUT POWER AS A FUNCTION OF SUPPLY VOLTAGE

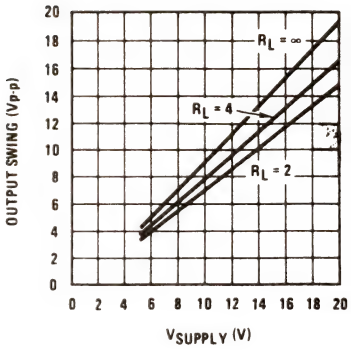


LM383/LM383A

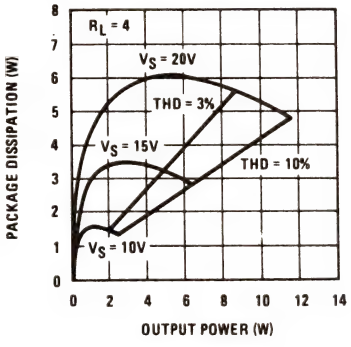
Supply Ripple Rejection vs Frequency



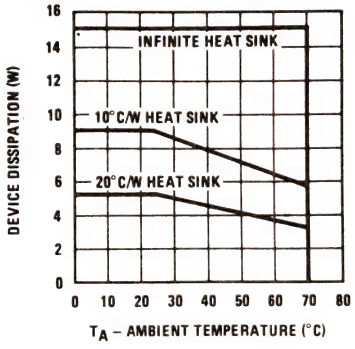
Output Swing vs Supply Voltage



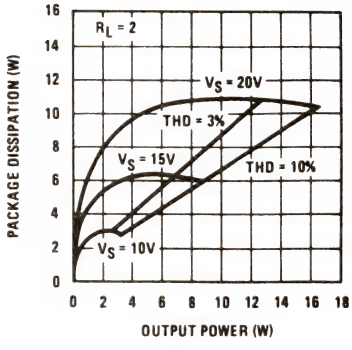
Power Dissipation vs Output Power



Device Dissipation vs Ambient Temperature



Power Dissipation vs Output Power



Electrical Characteristics $V_S = 14.4V$, $T_{TAB} = 25°C$, $A_V = 100$ (40 dB), $R_L = 4\Omega$, unless otherwise specified

Parameter	Conditions	Min	Typ	Max	Units
DC Output Level		6.4	7.2	8	V
Quiescent Supply Current	Excludes Current in Feedback Resistors		45	80	mA
Supply Voltage Range		5		20	V
Input Resistance			150		kΩ
Bandwidth	Gain = 40 dB		30		kHz
Output Power	$V_S = 13.2V$, f = 1 kHz				
	$R_L = 4\Omega$, THD = 10%		4.7		W
	$R_L = 2\Omega$, THD = 10%		7.2		W
	$V_S = 13.8V$, f = 1 kHz				
	$R_L = 4\Omega$, THD = 10%		5.1		W
	$R_L = 2\Omega$, THD = 10%		7.8		W
	$V_S = 14.4V$, f = 1 kHz				
	$R_L = 4\Omega$, THD = 10%	4.8	5.5		W
	$R_L = 2\Omega$, THD = 10%	7	8.6		W
	$R_L = 1.6\Omega$, THD = 10%		9.3		W
	$V_S = 16V$, f = 1 kHz				
	$R_L = 4\Omega$, THD = 10%		7		W
	$R_L = 2\Omega$, THD = 10%		10.5		W
	$R_L = 1.6\Omega$, THD = 10%		11		W
THD	$P_o = 2W$, $R_L = 4\Omega$, f = 1 kHz		0.2		%
	$P_o = 4W$, $R_L = 2\Omega$, f = 1 kHz		0.2		%
Ripple Rejection	$R_S = 50\Omega$, f = 100 Hz	30	40		dB
	$R_S = 50\Omega$, f = 1 kHz		44		dB
Input Noise Voltage	$R_S = 0$, 15 kHz Bandwidth		2		μV
Input Noise Current	$R_S = 100$ kΩ, 15 kHz Bandwidth		40		pA

Note 1: A 0.2 μF capacitor should be placed as close as possible to pins 3 and 4 for stability.

Note 2: The LM383 shuts down above 25V.

Note 3: For operating at elevated temperatures, the device must be derated based on a 150°C maximum junction temperature and a thermal resistance of 4°C/W junction to case.

4.11 LM383 8 WATT AUDIO POWER AMPLIFIER

4.11.1 Introduction

The limited supply voltage available in automotive applications requires amplifiers with an extremely high current output capability to drive low impedance loads if high power outputs are to be obtained. The LM383 is a cost effective, high power amplifer able to continuously deliver 3.5A. Typical output power levels are 5.5 Watts in 4Ω, 8.6 Watts in 2Ω and 9.3 Watts in 1.6Ω — all from 14.4V supplies. In Bridge amplifier circuits as much as 16 Watts into 4Ω can be obtained! Another unique feature of the LM383 is the package style — a five lead TO-220 that permits easy and effective heatsinking. The LM383 output stages are protected with both short circuit current limiting and thermal shut-down circuitry.

An equivalent schematic of the LM383 is given in Figure 4.11.1. The input stage of Q_1 and Q_2 drives the transconductance stage of Q_3. This stage is internally compensated with a fairly large pole splitting capacitor to give a unity gain crossover frequency of around 3mHz. This means that the amplifier is unconditionally stable for all values of closed loop gain, and the restricted bandwidth limits the possibility of r.f. radiation from the output that could cause interference in AM radio applications (see Section 2.3.10). The bandwidth for a closed loop gain of 40dB is still 30kHz (Figure 4.11.9), with careful design of the output stages keeping the *open loop* THD at 1%. The available pin-outs prevent boot-strapping the upper output stage, but the AB bias scheme (see Section 4.1.5) allows a negative swing to within a saturation voltage of ground (Figure 4.11.8). The LM383 uses an interesting dc bias scheme, shown in the simplified schematic of Figure 4.11.2 which has two main advantages. First, the dc gain is set internally to unity by the 20kΩ feedback resistor. This will minimize input offset voltages causing shifts in the quiescent output voltage. Secondly, the output voltage is automatically established at one half the supply voltage and will track with supply voltage to maximize the output swing capability. This is accomplished by biasing Q_4 from the 40kΩ resistor and D_2. Since D_2 and Q_4 base-emitter junction have the same voltage across them, then (neglecting base currents and assuming matching geometries) the current flowing in D_2 will be "mirrored" in Q_4. The collector of Q_4 will sink the same current as that flowing in the 40kΩ resistor connected to V^+. The collector current for Q_4 is sourced from the amplifier output stage through the 20kΩ resistor. Since V^+ appears across the 40kΩ resistor, $V^+/2$ is forced across the 20kΩ resistor and the output will track at one half supply voltage.

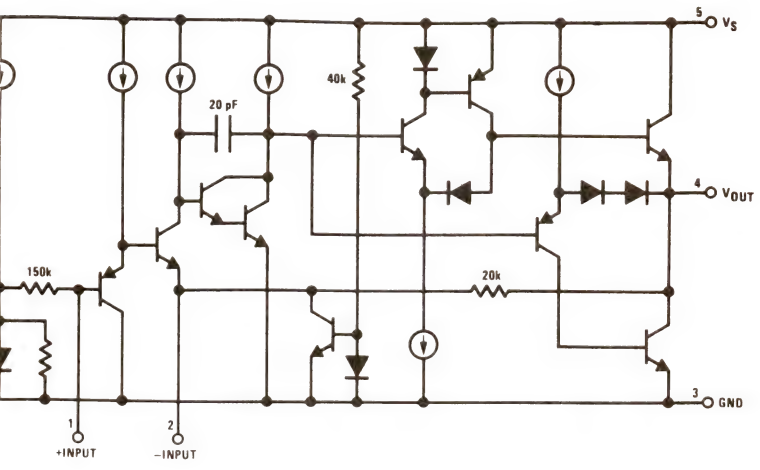


FIGURE 4.11.1 Equivalent Schematic of LM383

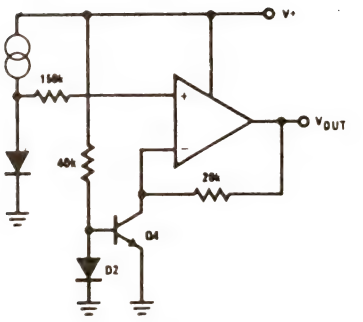


FIGURE 4.11.2 LM383 DC Bias Circuit

4.11.3 General Operating Characteristics

The closed loop gain of the LM383 is set by external components, Figure 4.11.3 showing a typical non-inverting amplifier circuit with A_V set by the ratio of R_1 and R_2. In practical terms the input dynamic range ($\pm 0.5V_{MAX}$) will determine the lowest useable gain for a given output power and load. The circuit of Figure 4.11.3 is set up for $A_V = 1 + R_1/R_2 = 101$, and it is worth noting the unusually low values of the feedback resistors. This can be attributed to the need for supply ripple rejection. Refering back to Figure 4.11.2, any supply voltage ripple will cause a change in the current in the 40kΩ resistor. This change is "mirrored" in Q_4 and without any external ac feedback the ripple voltage would appear attenuated by only −6dB at the output. However, if C_1 is large enough, the feedback network works to prevent any ac voltage change at the amplifier inverting input, so that the ripple appears as a current in the feedack resistor R_1. To a first order approximation therefore, the ripple at the output is given by the ratio of R_1 to the internal 40kΩ resistor.

By using a 220Ω feedback resistor, the ripple rejection ratio obtained is better than 40dB. Although low resistor values mean that more power will be dissipated in the feedback network, the dc voltage across R_2 is 0.7V, and that across R_1 is typically 6.5V, giving the power ratings shown.

The non-inverting input has a relatively high input impedance, but a large input coupling capacitor is recommended. Before turn-on, both the input capacitor and the feedback capacitor are at ground potential. At turn-on, the feedback capacitor can charge up more quickly than the internal bias resistor can charge the input coupling capacitor. This prevents the output from rapidly going up to the positive supply rail and producing a "pop" in the speaker. ▷

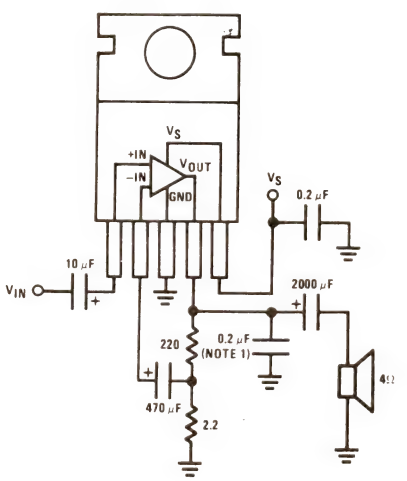


FIGURE 4.11.3 Non Inverting Amplifier (Av ≈ 40dB)

4.11.4 Layout, Ground Loops and Supply Bypassing

The very high output current capability of the LM383 means that careful attention should be paid the p.c.b. layout. A suitable component layout is shown in Figure 4.11.4. Parts worth noting are:

1) Supply decoupling capacitor (C_3) is located right at the supply pin.
2) A 0.2μF capacitor (C_2) is located at the output pin to prevent negative swing parasitic oscillation — *there is no damping resistor in series with this capacitor.*
3) The input ground is returned to the center pin of the I/C — the output or power ground is through the tab via the heatsink.

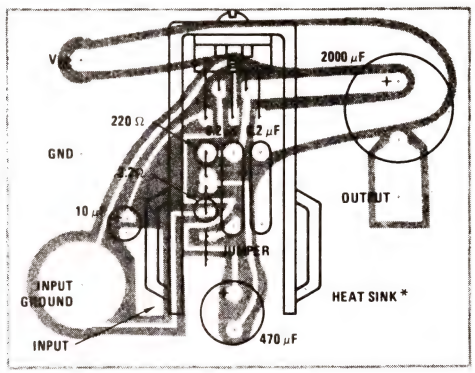


FIGURE 4.11.4 LM383 Board Layout

4.11.5 Output Power and Heat Sinking.

Device power dissipation vs. power output is indicated in Figure 4.11.6 for 4Ω loads and 4.11.7 for 2Ω loads. The ability of the LM383 to sustain these dissipation levels is given by Figure 4.11.5. For example, when driving a 4Ω load, the circuit of Figure 4.11.3 will have a maximum device dissipation of 3.5 Watts. This can be comfortably handled by a 13°C/W heatsink, such as the Staver V-5. If the load resistance is 2Ω, considerably more heatsink capability is required since the maximum device dissipation is now over 6 watts. In this instance a heatsink equivalent to the Staver V3-3-2 would be suitable.

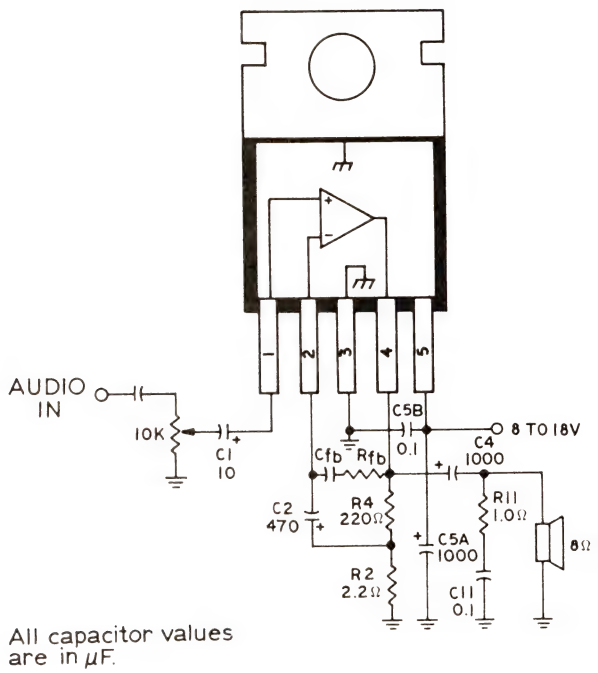
For most applications, since the tab of the LM383 package is grounded, the device can be bolted to the chassis to provide adequate heat sinking.

4.11.6 High Voltage Operation

The LM383 has a maximum supply voltage rating of 20V, above which the amplifier will shut down. The LM383A selection will withstand momentary peak supply voltages of 40V caused by supply-line transients. In an automotive application, a worst case transient is usually caused by alternator "load-dump" or loss of the battery charging load. When a 50 amp alternator loses the load, a peak output voltage of about 120V is generated and the transient on the supply line lasts for many milliseconds. Fortunately for the radio, this transient is clamped by an "A" line L-C filter to between 35-40 volts. The LM383A is rated to withstand 40 volts for 50mSecs.

ULN-3701Z / TDA2002

APPLICATIONS INFORMATION



All capacitor values are in μF.

FIGURE 1

A typical application using Type ULN-3701Z / TDA2002 is shown in Figure 1. Component values other than those shown will affect circuit performance as follows:

C_1—The value of the input capacitor may be reduced with the lower limit determined by the device's input impedance and the required low-frequency performance. For a 20 Hz low-frequency cutoff, and a minimum input impedance of 70 kΩ, the minimum recommended value is 0.1 μF. This capacitor's value is normally very large so that transients (turn-on, turn-off) are inaudible. Common 1 μF to 2 μF electrolytic capacitors will work quite well.

C_2—The negative feedback capacitor affects the power supply rejection ratio; the capacitive value is therefore usually very large. If the power supply has low ripple, the feedback capacitor value can be reduced. Increasing the value of this capacitor above the recommended 470 μF will *not* have a large effect on PSRR, due to the terminating impedance of the output resistive divider.

C_4—The output capacitor is chosen to provide the desired low-frequency cutoff with the lower limit determined by the load impedance. The values shown provide for a 20 Hz cutoff.

C_5—The large electrolytic can be considered to be part of the power supply and may be reduced in capacitive value or eliminated, depending on the particular supply. The low-value capacitor is usually a monolithic ceramic capacitor. It provides for high-frequency bypass and should have a low series resistance and a high self-resonant frequency.

R_2, R_4—The output resistive divider sets the closed-loop gain of the amplifier according to $A_v = (R_2 + R_4)/R_2$. The values shown provide for a gain of 100 and a typical PSRR of 35 dB. Connecting this divider to the d-c side of the output capacitor increases the supply current drain (by 32 mA for a supply of 14.4 V and $R_2 + R_4 = 222\,\Omega$) but will reduce any tendency toward crossover distortion.

R_{fb}, C_{fb}—High-frequency roll-off can be controlled with the addition of this series RC combination. Values are approximately $R_{fb} = 20 \times R_2$ and $C_{fb} = 1/(2\pi R_4 f_H)$.

R_{11}, C_{11}—This network is chosen to suppress spurious oscillation. The values shown should work for loads between 2Ω and 16Ω. Some changes may be required depending on factors such as circuit layout, load reactances, and lead length. A factor of 2× should be worst-case variation.

CIRCUIT MUTING

A simple muting circuit is shown in Figure 2. In this circuit, the a-c input signal is attenuated without affecting any d-c levels. The 47 μF capacitor and the 18 kΩ resistor can be eliminated if signal-level ramping is not desired.

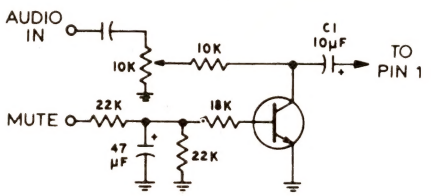


FIGURE 2

ELECTRICAL CHARACTERISTICS at $T_A = +25°C$, $V_{CC} = 14.4V$, $R_L = 4\Omega$, $f = 1$ kHz, $R_{fb} = \infty$ (unless otherwise noted)

Characteristic	Symbol	Test Conditions	Limits			
			Min.	Typ.	Max.	Units
Supply Voltage Range	V_{CC}		8.0	14.4	18	V
Quiescent Supply Current	I_{CC}	No signal applied	—	45	80	mA
Quiescent Output Voltage	V_4	No signal applied	6.4	7.2	8.0	V
Open Loop Gain	A_v		—	80	—	dB
Closed Loop Gain	A_v		39.5	40	40.5	dB
Total Harmonic Distortion	THD	P_{OUT} = 0.05 to 3.5W	—	0.2	—	%
		P_{OUT} = 0.05 to 5.0W, $R_L = 2\Omega$	—	0.2	—	%
Audio Power Output	P_{OUT}	THD = 10%	4.8	5.2	—	W
		THD = 10%, $R_L = 2\Omega$	7.0	8.0	—	W
		THD = 10%, $V_{CC} = 16V$	—	6.5	—	W
		THD = 10%, $R_L = 2\Omega$, $V_{CC} = 16V$	—	10	—	W
Efficiency	η	P_{OUT} = 5.2W	—	68	—	%
		P_{OUT} = 8.0W, $R_L = 2\Omega$	—	58	—	%
Input Impedance	Z_i		70	150	—	kΩ
Power Supply Rejection	PSR	f_{ripple} = 120Hz, V_{ripple} = 0.5V	30	35	—	dB
Equiv. Input Noise Voltage	v_N	f = 40Hz to 15kHz	—	4.0	—	μV
Equiv. Input Noise Current	i_N	f = 40Hz to 15kHz	—	60	—	pA
Input Sensitivity	V_{in}	P_{OUT} = 0.5W	—	15	—	mV
		P_{OUT} = 0.5W, $R_L = 2\Omega$	—	11	—	mV
		P_{OUT} = 5.2W	—	55	—	mV
		P_{OUT} = 8.0W, $R_L = 2\Omega$	—	50	—	mV
Input Saturation Voltage	V_{in}		—	600	—	mV
Frequency Response (−3dB)		$C_{fb} = 0.039\,\mu F$, $R_{fb} = 39\Omega$	40	—	15k	Hz
Thermal Resistance	$R_{\theta JT}$		—	—	4.0	°C/W

YOU CAN LEARN some amazing things from the computer bulletin boards. Not all of them useful, but amazing nonetheless. You can often find out about new items of hardware and software, long before their public debut. The fact that the following item, found on a BBS that shall remain unnamed to protect the guilty, reads rather like many of the computer trade press releases that cross the front desk here at AEM had us suspicious from the start. Take it as you will:

"We at Bushlit Micro Supplies pride ourselves on doing things just that little bit bigger and better.

"Our liquid helium cooled laser printer can turn out ten A4 pages a minute at 10 metres. No need to fiddle around loading those cut sheets – simply line them up against the wall, push the button and stand well back!

"Each printer is supplied with a warning sticker for the door, a klaxon which sounds when something goes wrong and an *I was Tattooed by a Runaway laser Printer* badge to amaze your envious friends!"

Friends of the fly

Followers of this column will recall the indefatigable Professor Donald F. Richards of the Sackville Academy of Lateral thinking (S.A.L.T. of the Hawkesbury) of Ebenezer, NSW. His various contributions to the body of erudite and learned research papers pouring from this country's institutions have been exceedingly uplifting, but not exactly bearing fruit yet, as such.

That is, perhaps, until now. Or, I should say, until last year.

Cast your mind back, or just go over your back issues, to the October 1986 edition. Prof. Richards' first contribution. It was all about zippers. Fly zippers, to be exact. That which holds the front of your trousers together.

In that amazingly prescient foundation paper on the subject, which arose from a lecture given on the prestigious and widely heard *Robyn Williams' Science Show* on the ABC in 1983, Prof. Richards detailed his research into *Closure Aberration* (or, C.A., as it is known in research circles, and even squares), a problem that afflicts some 47% of half the population; the male half. The problem, simply stated, is: leaving one's fly zipper undone.

Richards suggested an invention to warn sufferers that closure was not effected; to zip up.

Clearly inspired by Richards' lead, such a device has been invented, a working prototype being demonstrated in Tokyo last year.

We learned of the story from another learned journal, *Materials Edge*, of January 1988. The report detailed the efforts of Japanese industry to rekindle Japan's inventive spirit which apparently the nation lost somewhere along the way to becoming the world's most successful industrial nation, particularly excelling in consumer electronics, as Australians have discovered, to their cost.

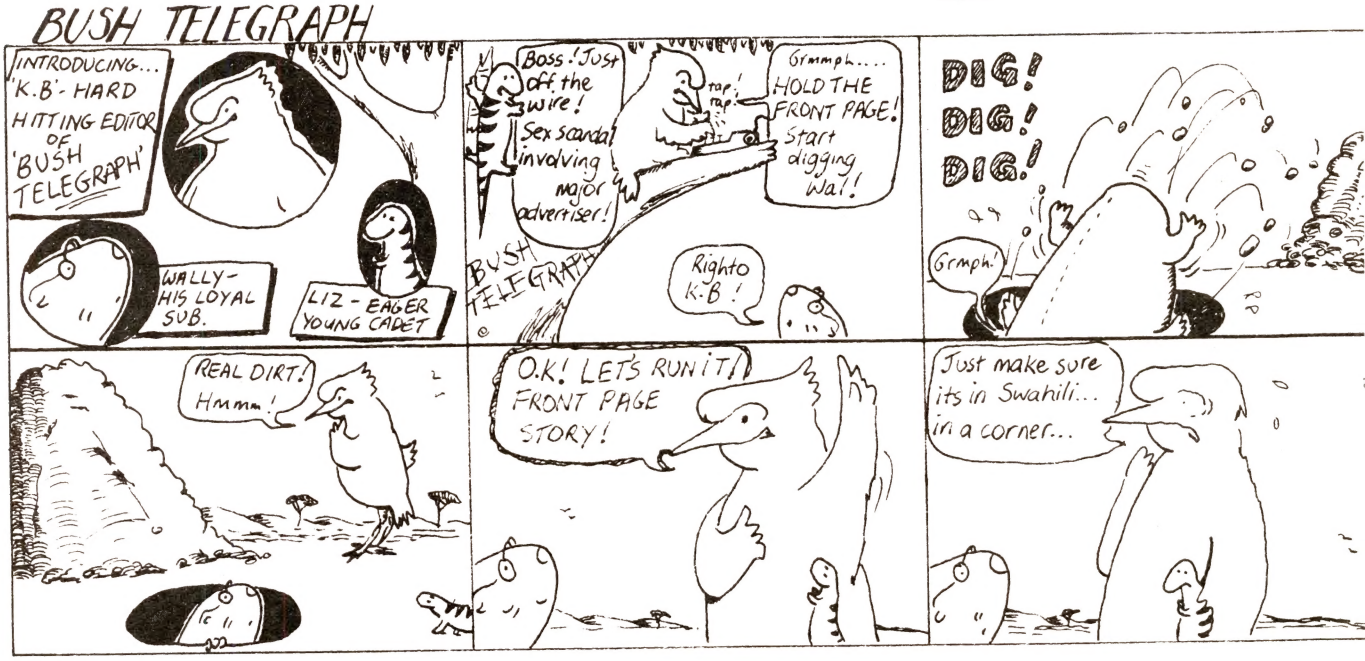
It was the manufacturers' strategy of employing "reverse engineering" that brought about this parlous state (which we understand is different to the celebrated Gough Whitlam's parlous state – Queensland, now being taken over by Japanese interests, according to the daily press).

Apparently, the Japan Battery and Appliance Association sponsored a competition last October-November, offering 300 000 Yen in prize money. It called for wacky and humourous inventions, the only requirement being that they run on dry cell batteries. We'll spare you the details of the sushi cutting board that makes the raw fish slices twitch as if still alive, and the electric chin scratcher.

The prize money was taken by the inventor of the battery-operated buzzer that attaches to your fly and sounds a warning if it's left open for more than 50 seconds. The 62-year old inventor, Yasuhide Maezawa, confessed "When you get old, you tend to forget."

Don Richards expected his concept would bear fruit in Australia and expected it to bring improvement to Australia's balance of payments. But it seems Mr Keating will now be writing more cheques to the Mitsubishi Bank to square off our debt to the Yen. Good try, Don!

This month we introduce what we hope to be a regular feature – The Bush Telegraph, from cartoonist Amanda Biggs. The Bush Telegraph is fictional. Any resemblance to characters or persons alive or dead is purely coincidental. Follow the adventures of K.B., Wally and Liz, see Thnake-in-the-Grath thwarted, and more.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INTRODUCING... 'K.B'- HARD HITTING EDITOR OF 'BUSH TELEGRAPH'
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LIZ - EAGER YOUNG CADET
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rap! rap!
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